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The Midland Naturalist

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Editorial Announcement.

The Middle Western States considered geologically, topographically, and climatologically, form a great natural province, showing points of marked contrast with the region of the Eastern and Middle States on the East, and that of the elevated Rocky Mountain Plains on the West; in some respects connecting the two, yet geographically distinct from both.

Our region of the Prairies, including as it does the several states which in some part touch the shores of Lakes Michigan and Superior, together with the land-locked Missouri and Iowa, and extending westward only to the middle part of Kansas or Nebraska and of the Dakotas, from the days that it first began to be known, a hundred years ago and more, has been noted as geographically a peculiar region. The distribution of the diverse forms of living things in nature is largely governed by geographic limitation. Every continent, and every subdivision of every continent, has its own kinds of plants and animals. Biological types are modified and diversified according to circumstances of topography, soil, climate; and our prairie country was noted from the first as the habitat of certain animals and plants not found at all in the region from the Allegheny Mountains eastward, nor yet in the South beyond the Ohio River.

In zoology we have no descriptive handbooks readily available showing the peculiarities of Midland animal life and form, but in botany happily it is otherwise. Here the earliest manuals credit many peculiar and interesting type-plants to the region of the prairies exclusively. In the earlier issues of Alphonso Wood's and Asa Gray's familiar books, such types as the following are attributed to no part of the United States but the Prairie States of the valley of the upper Mississippi and westward:

* April 15, 1909.—Pages 1 to 28.

Anemone Nuttalliana,
" Caroliniana,
" parviflora,
Ranunculus affinis,
" rhomboideus,
Clematis Pitcheri,
" Fremonti,
Delphinium azureum,
Argemone platycerus,
Draba cuneifolia,
Erysimum asperum,
Thelypodium pinnatifidum,
Cleome integrifolia,
Viola pedatifida,
" Nuttallii,
Geum triflorum,

All these are from the earliest pages of the old manuals, and, if we were to proceed to the Leguminosae, there we should find whole genera ascribed to the Prairie regions in this same way. There is Baptisia with six species, Dalea with four, Petalostemon with five, Astragalus with sixteen, Oxytropis with three, all these genera either fully represented to the eastward of Indiana, or not all; while such types as Glycyrrhiza, Hoffmanseggia, Desmanthus, and Schrankia, are unknown except from Illinôis westward.

It is the most primitive books of the United States botany—those printed before the field of the Middle West had received anything more than casual notice—which thus show in the aggregate some scores of plant-types unknown to the eastward of Michigan and Indiana. Today there is evidence that a new era for middle western nature study is upon the dawn. At least as regards plant life and form it is tacitly conceded, if not openly, that the field was formerly too much neglected. Between the New Gray's Manual lately issued, and the earlier editions there are contrasts which tell strongly in favor of the idea that the Prairie Region plant world is a thing as much apart from that of New England and New York, as it is from that of the Gulf States. Compare this new edition of Gray with the sixth, which preceded it by less than twenty years. Up to within a few years, according to all the books, among the commoner trees there was one kind of wild crab-apple, Pyrus coronaria,—indigenous to the whole North all the way from New York across to Kansas and Minnesota. The latter proposition is that the above name formerly, and wrongly, was made to embrace two different species, P. coronaria of the Middle States and P. Iowensis, restricted to the Prairie Midland country. All except the most recent books tell of only one sort of Virginia Creeper—Ampelopsis—common from the shores of the Atlantic north and south to away beyond the Mississippi. The newest manual names four different kinds, two of which are characteristic of the Midland Section. Akin to the Crab-apple is the genus Crataegus, which according to the older standards, exhibited a number of species

ranging all across from the Atlantic to and throughout the Prairie Region, but now the newest book attributes to the Prairie States at least a dozen sorts as peculiar to this region.

Many another genus of trees is now of late represented as having species restricted to the Midland; and the like showing is made in the case of many an alliance of humbler plants. The Blue-eyed Grass, Sisyrinchium, in regard to which it was until lately taught in all the books, that there is no distinction between eastern kinds and middle-western kinds, it is now affirmed—and none question it—that no less than eight species are peculiar to the Prairie West, four of them,—S. hastili, S. Farwellii, S. strictum, and S. apiculatum not having yet been found outside the State of Michigan.

The few examples thus brought forward may sufficiently indicate the suitability of our having here in the midst of this interesting and still new field, a journalistic medium of intercommunication and publication of Midland nature students, and this without thought of rivalry with old and well established journals, most of them general in their character and almost without local tinge.

Local journals such as the Ottawa Naturalist, Rhodora, the Ohio Naturalist and others all seem to have their mission and are fulfilling it well. The Midland Naturalist, while it may not hope soon to emulate the least of the forgoing, has certainly its own floral and faunal territory, and one that to the present time has remained unoccupied journalistically. In our investigations of biological and kindred subjects at Notre Dame we have for some time realized the desirability of having some ready medium of publication for matter appertaining to those branches of Natural History to which attention has been given. In this venture, therefore, we are meeting, first of all, a demand of our own. Though there is such a vast field for research on the plant and animal life of our Middle Western country, studies in general biological science and related subjects will not be excluded from our interest. Articles on General Morphology, Ecology, Histology, Physiology, Taxonomy, and the History of Botany and Zoology, etc., will at all times be welcomed to these pages. It is hoped, however, that the Midland Naturalist may meet with some welcome, and prove a stimulus and help to many a Midland nature student, not only in colleges and universities, but also to the equally interested and efficient workers in private life outside of schools.

Resting Spores of Cosmarium bioculatum, Breb.

J. A. NIEUWLAND.

The material that is the subject for the present article was collected between May 1 and 14, 1907, on the University grounds in a small rill along the branch of the Michigan Central Railroad, between Niles, Michigan and South Bend, Indiana. The locality is rich in more or less uncommon algal material and the larger portion of the valuable specimens collected in the last few years for the department of Botany, in the line of fresh water algae, was obtained from the immediate vicinity, that is within a radius of a half mile. Until very lately the surface water of the surrounding higher land collected in small pools along the railroad, and the rill from which this material was obtained had its origin in an old barrel that had formerly enclosed a spring. Its water flows along the tracks of the road into the St. Joseph River. Drainage systems have lately been put in and usefulness of the locality in the production of algal material is very much impaired. From July to November the streams and pools were completely dried up except after excessive rains and even then they were dried up in a few days. The small stream was sluggish in its flow at intervals thus affording places for the lodgement of the plankton in the weeds and grass. The plankton was so abundant that it could be collected by the gallon. About the 15th of May the desmid material contained mostly Cosmarium bioculatum, Breb., Staurastrum rugulosum, Breb., Staurastrum polymorphum, Breb. Cosmarium botrytis, Menegh., and Spirogyra tenuissima (Hass) Kutz., with lateral conjugation only, Zygnema insigne, (Hass.) Kutz., in fruit, various forms of diatoms, Vaucheria sessilis, (Vauch.) DC., Vaucheria geminata, (Vauch.) DC,. Draparnaldia glomerata (Vauch.) DC., Palmella hyalina, Breb., and Chaetophora elegans, Ag., also several forms of unicellular Myxophyceae. The desmid material was replaced by Mougeotia scalaris, Hass. so abundantly in the state of sexual reproduction that we considered it the best material we have ever found in that stage. The following algae were also present in the desmid material and all were abundant at different times between the beginning and the end of May: Cosmarium intermedium, a very small form of Penium margaritaceum, Breb. several species of monoecious and dioecious

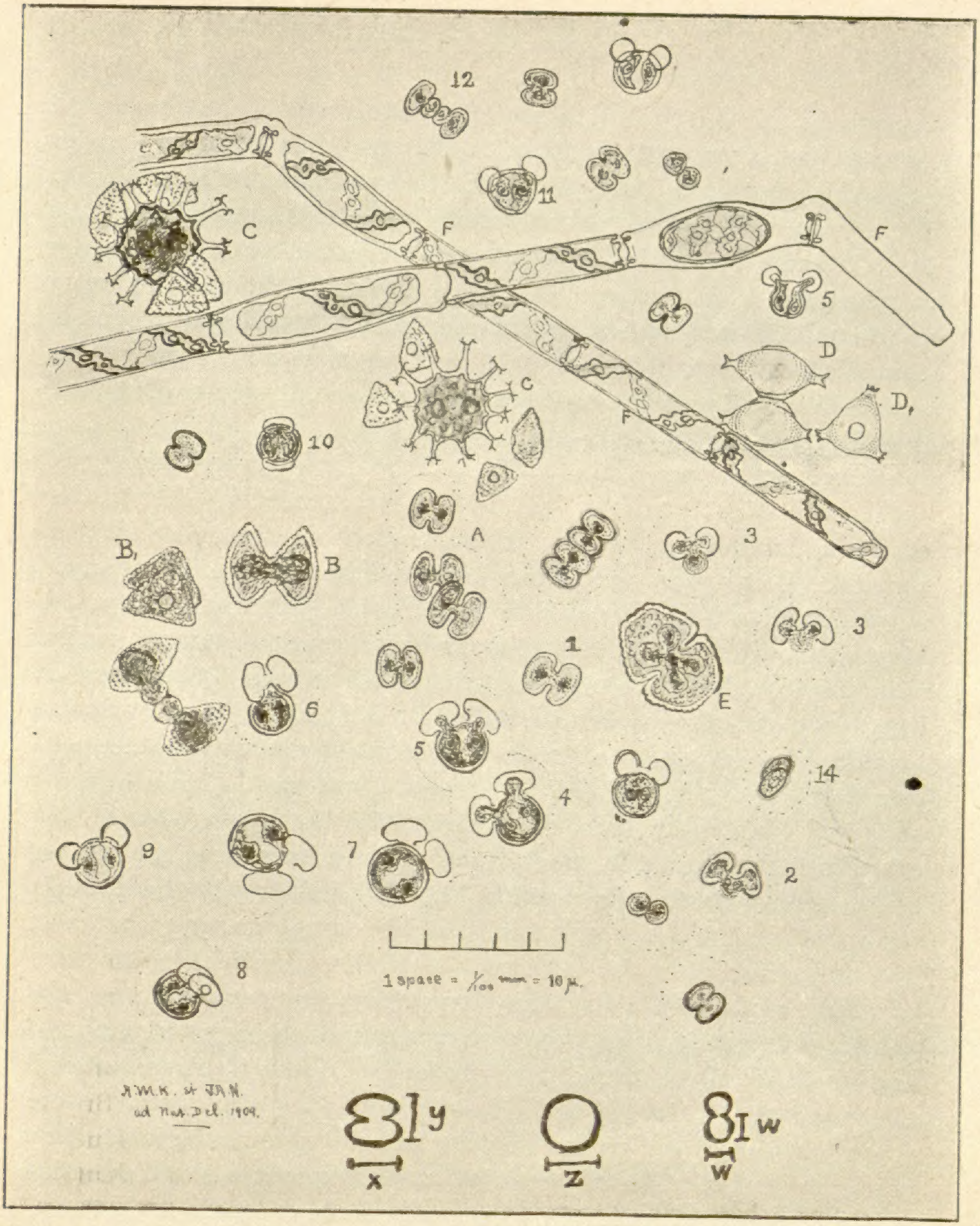

PLATE I.

ASEXUAL RESTING SPORES OF COSMARIUM BIOCULATUM, BREB.

Figures 1–11. Stages of formation of resting spore.

1. Vegetative stage. 2–3. Separation of the semicells with formation of vesicle. 4–6. Later stages of formation of spore from the vesicle. 7–11. Fully formed spore with empty semicells in various position in the surrounding mucilage. 12. Cosmarium bioculatum, vegetative divisions. 14. End view of vegetative stage. A Same as 1, front view. B. Staurastrum rugulosum, Breb. B. End view of same. C. Formation of zygospore of same. D. Staurastrum polymorphum. Breb. Side and end view of vegetative stage. E. Cosmarium botrytis, Menegh. F. Spirogyra tenuissima, (Hass.) Kütz.

W. X. Y. Z. Measurements of Cosmarium bioculatum.

Side View, W. = 6.75μ

Front View { X. = 13.50μ—14.62μ.
Y. = 13.50μ—15.75μ.

Zygospore, Z. = 13.5μ—24.μ. (Usual size, 18μ. diam.)

Oedogonia, a very small form of monoecious Bulbochaete, all more or less abundantly in fruit. Not more than a hundred yards from this spot in a pool was found Mougeotia mirabilis Al. Br. in all stages of sexual reproduction by lateral conjugation and in such large quantities that it could be raked out of the water in masses of two or three pounds at a time. Some miles away another pool was found containing Cosmarium botrytis rather abundantly in conjugation, and Penium margaritaceum not so commonly fruiting and a small amount of several species of vegetative Closterium.

The water containing the Cosmarium bioculatum was collected in vessels and the plankton concentrated by decantation of water, and taken to the laboratory where the material was studied. Some was fixed and the rest kept alive in aquaria. Several quarts were taken daily between the first and the 13th of May, after which date the specimens began to disappear gradually. Material transferred to the laboratory was invariably arrested in its growth after removal from its native habitat. The Cosmarium bioculatum continued to produce asexual spores but subsequent development of the full developed spores ceased. The full grown spores of the Cosmarium bioculatum and the zygospores of the other forms remained in the laboratory for a long time but neither could be brought to germination. After persisting in the aquaria for months alive they eventually disappeared, leaving no trace. The following year the stream and all the adjacent pools were carefully examined every few days for a reappearance of the plants. Only a few vegetative Staurastrum specimens were found and no Cosmarium bioculatum whatever. From the live material examined at the time of collection the following observations were recorded. The fixed and preserved material now in the laboratory jars is quite as good for the description of the processes as it contains all the various stages in the formation of the spores.

Staurastrum rugulosum, Breb. and Staurastrum polymorphum, Breb. were found, mostly in the latter stages of zygosporic reproduction the former so abundantly that the zygospores are more common in the material than the vegetative forms. Few early stages were found most of the zygospores having already fully developed spines with hooks.

Both vegetative and asexually reproducing stages of Cosmarium bioculatum, were extraordinarily abundant, though vegetative division of the cells was uncommon, and all the stages of the formation of the resting spore could be studied. These

various stages are shown in the plate in figs. 1–11. There was no need of hunting for the intermediate stages as nearly every particle of plankton contained them all, and often the field of a one-eighth microscopic objective with one inch ocular presented a complete series of stages of spore formation.

Following is a description of the process of the formation of the resting spore. Two semicells of the desmid, Cosmarium bioculatum separated from one another as the plants usually do in the formation of zygospores, only one individual, however, being engaged in the process. The protoplasm from each semicell emerged and formed a transparent globular vesicle. This vesicle gradually became invested with a thick cell wall on reaching full size. The two chromatophores with nuclear bodies each with a small body in it resembling a nucleolus on entering the vesicle took up positions at opposite pole of the vesicle only fusing their protoplasm along a thin median band, thus seeming at least in the early stages of the spore formation to maintain their individuality in the spore. The whole spore as also the vegetative stage of the desmid was invested with a thick mass of mucilaginous material. This fact was beautifully demonstrated in staining with diluted Delafield's Haematoxylin bringing up in alcohol counterstaining with Magdala Red and mounting in Venetian turpentine or balsam. The preparations thus made showed the cell wall of the desmid as also of the vesicle a rather deep purplish blue, the cell contents especially the chromatophores a bright red, and the mucilage coat pale lilac to purple. Thus it was easy to prove that one and only one desmid was engaged in the process of spore formation and therefore that it was not conjugation. Other preparations, using Magdala Red alone, showed the cell contents more clearly as the cell wall could be bleached to any degree of paleness or the stain quite removed by measured exposure to sunlight. Though thousands of the spores of Cosmarium bioculatum were examined under various conditions of staining and particularly in the study of the live material not a single case was found where more than one individual was noticed in the formation of the spore. The method of the formation of the spore is then a purely asexual one, unless the union of the contents of one semicell of an individual with those of its other half or of the other semicell can be considered a sexual process. The contents of each semicell of an individual can of course be supposed to become a gamete to the other half, and the resulting spore could in this sense be considered a zygospore by a degenerate form of conjugation.

A process has been described in which two individual desmids conjugate, each semicell of one with a corresponding semicell of another individual, the result being the formation of two zygospores from a single conjugation of only two desmids. In Cosmarium bioculatum only a single individual desmid was ever noticed to effect the formation of the spore. The latter was devoid of spines and resembled the ordinary zygospore reported for the individual.

Some attempts were made to obtain the subsequent stages of the development of resting spore in the laboratory and in the field. Though the material remained in the spore state for months it eventually disappeared and in the laboratory this was principally due to the ravages of minute water insects that could not be eliminated from the aquaria. In attempts to study field material no better results were obtained. Late in the summer the stream had dried up, not however, before all the desmid forms had disappeared. The following year, as already stated, practically no desmids were found and absolutely no Cosmarium bioculatum. Nothing but some ordinary forms of algae such as Vaucheria sessilis and Vaucheria dichotoma, (Lyngb.) Ag. some small forms of Spirogyra, Zygnema insigne, and vegetative Mougeotia scalaris.

A Biological Study of Noctiluca miliaris, Suriray.

A. M. KIRSCH.

Some months ago there was sent to the Zoological laboratory of the University of Notre Dame, a vial containing what proved to be Noctiluca, collected on the Oregon shore of the Pacific Ocean, and with the specimen a request was made what it might be. Noctiluca is a comparatively well known animal in zoological literature, and Dr. O. Bütschli in his work on the Protozoa, which forms the first volume of Bronn's "Klassen und Ordnungen" mentions no less than forty-one authors that speak either directly or indirectly of this highly interesting flagellate protozoan. Our experience above referred to illustrates that many workers in Zoology need more than the classical literature to identify the many curious animals they now and then meet with. It is not the primary purpose of the Midland Naturalist to publish exhaustive memoirs or treatises for specialists in Biology, but rather to give

helpful knowledge to the middle class of naturalists scattered over our territory.

Without entering deeply into the historical part of the literature of Noctiluca, we may mention that in regard to the phosphorescence of sea-water so often noticed along the sea coast it was very early found that Noctiluca was one of the causes of this phenomenon. J. Sparshall in 1742 investigated this phosphorscence, and Bütchli states that he has no doubt that the glimmering sea animalculae observed by Sparshall were really Noctiluca.

The Abbé Diequemare in 1775 also observed and studied the phenomenon of phosphorescence on the coast at Havre, France, and by filtering the water proved that the phosphorescence was not due to the water, but to the small animals which he had gathered on the filter. The physician Suriray of Havre, however, left us in no doubt whatever that the animalculae were observed, and recognized by him. His illustrations and especially that of the striated structure of the tentacle of the animal, together with his accurate description have given him the right to name the animal Noctiluca miliaris, a name by which it is still known. In 1811 he had sent his treatise on the animal to the Academy at Paris but it was not published until 1836.

Suriray classified the Noctiluca among the polyps, and others had placed it in with the medusae. Doyère and P.van Beneden, however, regarded Noctiluca as a member of the sarcode animalculae of Dujardin. The latter himself placed it among the Foramiuifera or the Rhizopoda, but Ernst Haeckel placed it among the Flagellata (Mastigophora), and created for it a special order called the Cystoflagellata. Into this order was also placed Leptodiscus of R. Hertwig, 1877, so that at present the Cystoflagellata contain only two genera, Noctiluca and Leptodiscus.

Noctiluca miliaris, Suriray, is at present the only commonly recognized species. Bush in 1851 had described a second species under the name of Noctiluca punctata, but this was considered as not different essentially from N. miliaris. Gigioli (1865-68) after his journey around the world described what he called Noctiluca homogenea, and Noctiluca Pacifica. Bütschli says concerning these supposed species: "Since there are no illustrations given and as the short descriptions do not inspire confidence, I regard them as doubtful species."

All authors so far seem to agree that Noctiluca miliaris is cosmopolitan and the genus monotypic, and therefore more

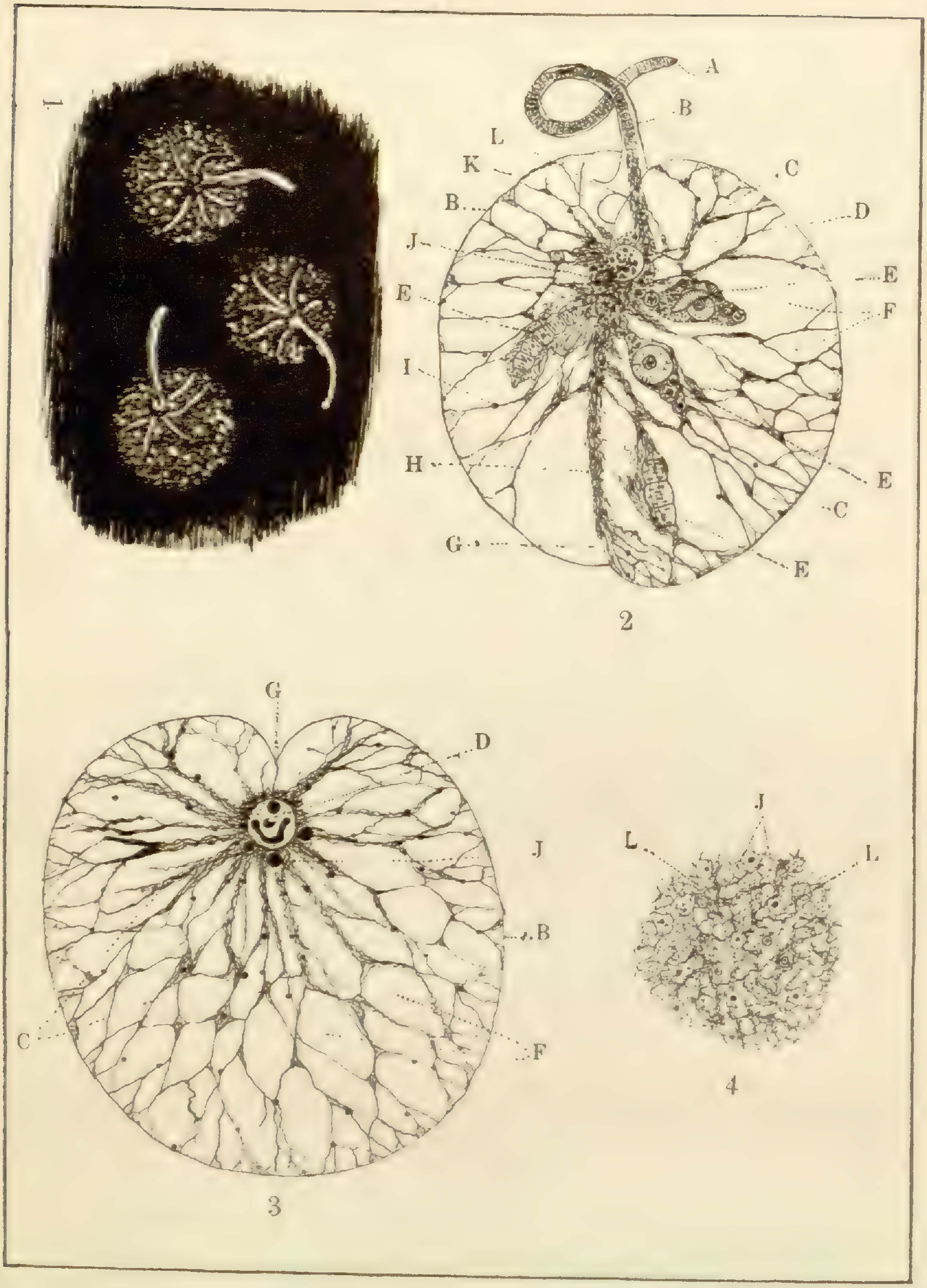

PLATE II.

Fig. 1. Noctiluca miliaris, Sur. as it appears phosphorescent in the dark.

Fig. 2. Oblique view of an individual with tentacle facing the observer.

A. Tentacle, B. Cell wall extending over the tentacle.

C. Reticular threads of the protoplasm.

D. Nucleus.

accurate study is required before deciding whether Noctiluca Pacifica can be regarded as a valid species.

The material at my disposal is not sufficiently well preserved to allow me to pronounce an opinion about the specific character of the Pacific Ocean animal, and moreover it is only by the study of the living specimen of such a delicate animal that one could be justified in giving a scientific opinion. The present paper was prepared partly for the benefit of those on the Pacific coast who are in a position of obtaining fresh material for study. Some fundamental data as to the structure of Noctiluca miliaris will be given and I leave it to others to decide whether Noctiluca Pacifica be a well grounded species.

At one time Noctiluca had been placed among the Medusae, but a closer examination of the structure of the animal reveals to the microscopist the fact of relationship to the phylum of the unicellular Protozoa, and that it belongs to the class of the Flagellata. Owing to its bladder-like appearance we would refer it at once to the Cystoflagellata as its proper order. Its name seems appropriate, meaning "night light," evidently referring to the property of producing diffused phosphorescence of sea water in the dark. This light is apparently produced by the layer of protoplasm, situated immediately under the cuticle, and is caused by some process of oxidation. The light is by some said to be caused

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E. Algae and diatom carapaces; (Food inclusions) in the protoplasm.
G. Buccal groove. F. Vacuoles containing water.
H. Bundle of reticulum continuing the groove, and forming the rod.
I. Fat globules stained black with osmic acid.
J. Central protoplasm containing numerous fat globules I. and nucleus, D.
K. Mouth.
L. Bundle of reticular threads connecting the central protoplasm with the tentacle where they become transversely striated.

Fig. 3. Optical section of Noctiluca perpendicular to the groove, G. and passing through the central protoplasmic mass. D. Nucleus. J. Central protoplasm, B. Cell wall. F. Water vacuoles. C. protoplasmic threads.

Fig. 4. A small portion of protoplasm showing its structure as it appears just under the cell wall.
J. Trabeculae of the reticulum.
L. Enchylema filling the spaces between the threads of the reticulum, and containing the fat bodies, (Inclavata.) [Partly after Carnoy.]

by the oil globules abundantly found in the meshes of the protoplasmic reticulum.

As to the form of the animal it is more or less globose, and had it not been called Noctiluca—"night light"—on account of its phosphorescence, one might, on account of its shape, have been tempted to name it "Sea peach," owing to its remarkable resemblance to a peach, or apricot. Hertwig states that, in size, the animal may be one millimetre in diameter, but the largest that the author ever found, after examining thousands, was no greater than than 640 micra in diameter.

The movement characteristic of the animals may be described as a rolling, swinging motion. They remain quite near to the surface of the sea, and in such numbers that they cover the upper layers of the water like a mass of jelly, at such times exhibiting at their best the wonderful phosphorescence of the sea.

Considering the fact that Noctiluca belongs to the unicellular animals, and that its structure is simple, it is still very striking. The animal is covered with a cuticle or cell-wall which we find to be about 1 to 2 μ. in thickness. The author could make out no definite structure to this membrane, though from the observations of Cienkowski one would infer that some structure exists. Cienkowski regards the cuticle as a more firm part of the interior, to use his words, "*eine viel festere Consistenz als der Inhalt.*" In fact, Bütschli considers this cuticle identical with von Mohl's "primordial utricle," or with the "structured cell-wall" of Carnoy, in contradistinction to an amorphous secretion serving as a special protective membrane or covering. Bütschli, however, doubts whether this holds good for the cuticle that covers the tentacle.

As appears in our illustration, this cuticle shows with marked distinctness around the tentacle, and we would be inclined to think that at least here the cuticle is chemically and physically different from that which covers the rest of the animal.

A noticeable external structure of the animal is the groove which extends about one fourth around the periphery, and may be termed the peristome groove, and is continued by an elevation for some distance. (Fig. 2, H.)

The tentacle already mentioned is the most noticeable external structure, and it arises from the border of the peristome groove. This tentacle is very characteristic, and has given rise to considerable comment as to its origin, though no one has, in our opinion, given a satisfactory explanation as to its homology. In fig, 2, we notice the striated appearance of this organ, the striations being,

however, confined to the protoplasmic interior. A bundle of fibres starting from the central mass of protoplasm around the nucleus is very evident, and these become abruptly striated in the tentacle. Special emphasis should be laid on this fact, as it is a direct proof of Prof. Carnoy's view concerning the physiological role that the reticulum of the protoplasm performs in the life functions. According to him, "the reticulum of the protoplasm is the sole seat of irritability and contractility, and it alone determines the physical movements of living things."* We see in this tentacle with its striated structure a transformation of reticulum into a muscle fibrilla.

From a phylogenetic point of view we might call attention to the similarity of the structure of the tentacle of Noctiluca to the stalk of a Vorticella. Such questions as the following might be asked: "Might not the ancestral forms of Notciluca have been fixed by a stalk like Vorticella? Is Noctiluca a freed Vorticella with the stalk persisting as a tentacle and still exhibiting the same structure? In other words, has Noctiluca the same ancestral forms as Vorticella?" These are questions that intrude themselves on our mind while we study the structure of Noctiluca and particularly of its tentacle. In Vorticella the stalk is the organ of motion, the cilia being used only to convey the food to its mouth. As long as the stalk is fixed at its distal end, the motion of the animal is limited, and it is necessary that it have organs to bring food to the mouth. In Noctiluca the stalk being freed from its permanent attachment it becomes an organ of free motion. The crown of circumoral cilia, therefore, becomes useless, degenerates, only a single cilium remaining to trace the ancestral relationship. Close to the mouth of the animal and between it and the tentacle, is noticed a zigzag line which Huxley called the tooth, and near it a small lobule called the lip from which arises the solitary remaining cilium which is seldom seen in preserved material. Near this is the slit-like opening, the mouth, leading into the interior of the central protoplasm. All the structures just mentioned are situated in the buccal groove. From the end of the buccal groove a string of fibrillar protoplasm extends for some distance farther and produces a raised ridge (Fig. 2, H). This is the rod, the function of which is not known.

After thus completing the study of the external anatomy of Noctiluca, we may penetrate into the labyrinth of its internal structure. Immediately under the cuticle we see as represented in

* Carnoy.—Biologie Cellulaire page 196.

fig. 4, the fine structure of typical protoplasm. We notice first the trabeculae of the delicate network or reticulum, and the enchylema filling the spaces between the network. At intervals we notice globules of fat which stain black with osmic acid. Deeper into the interior of the animal as in fig. 3, we notice the nucleus surrounded by the central mass of protoplasm, situated immediately under the buccal groove. In the live animal the fat globules move along the shreds of reticulum, which movement is evidently caused by the contractions of the reticular meshes themselves. These meshes are continually rearranging themselves. Some disappear and new ones again reform so that the pattern seen in fig. 3 may change in a short time into an entirely different one. The meshes of this network are evidently formed by the banding together of the plasmatic reticulum caused by the absorption of water which fills the large spaces called water vacuoles.

From figure 2 of the plate we obtain a synthetic view of the whole animal, and a hetter impression of the relationship of the parts. We find certain bodies engulfed in the protoplasmic mass and we call these inclusions, as they are evidently things not belonging to the structure of the animal nor formed by the animal. The shape and markings of these foreign bodies show them to be cells of algae and carapaces of diatoms. They are the food of the animal and were introduced at its mouth and are lodged in the food vacuoles.

In the central mass of the protoplasm is noticed the nucleus a body necessary to every cell. Though much could be said about this nucleus, its structure, its transformations incident to cell division, its essential necessity in the porcess of generation, and its chemical composition, we can not enter upon these questions here.

After this brief morphological examination of Noctiluca, we might make a few notes on its physiological functions and chemical composition. Living material is of course needed for physiological study. The first thing that strikes us here is the wonderful activity of the animal's movements. We notice first the power of locomotion and that the tentacle is the organ of this motion. Beside this there is the wonderful life-activity displayed in the interior of the animal, the contractions of the meshes in the network already referred to, their disappearances, reformations and changes, as also the flowing of the fine granules of the enchylema along the strands of the reticulum, accompanied with the streaming about of the fat globules. We recognize in this movement the tendency to supply the distant parts of the animal with food. In other words this is a

crude mode of circulation analogous to that of the higher animals. The minute granules of the enchylema may be analogous to the blood corpuscles. Wherever we observe in living things this streaming movement of the protoplasm, the granules seem to be the food carriers. The location of the food vacuoles in the interior of protoplasm corresponds to a primitive digestive system. From these interior food masses, the meshes radiate in all directions and from them likewise the streaming of the protoplasm proceeds. Careful observation will reveal the method of the ingestion of the food and its rapid digestion in the food vacuoles, (extemporized stomachs) as also the egestion of the undigested particles by the same opening through which ingestion took place. Thus in the unicellular animals we have all the physiological functions exhibited in their simplest ways. We realize here the meaning of the expression of Carnoy: "It is therefore to the cell, that abyss of littleness, that we must descend to seize life in its material source and wrest from it some of its secrets." Dr. Winfield S. Hall, professor of Physiology of Northwestern College of Medicine, also aptly gave utterance to this truth: "No one can do real and serious work in human physiology, who has not mastered Cytology.".

Noctiluca possesses no differentiated nervous system but as it shows irritability as produced by the nervous system of the higher animals we refer this characteristic to its undifferentiated protoplasm.

The process of reproduction is the last physiological function to which we may call attention in Noctiluca. The mode of repr duction is by cell division and by budding, in each the nucleus takes the prominent part in the process. We can not go further into detail in describing the methods, but for information we must refer the reader to the classical works among which we might quote Bronn's "Classen und Ordnungen."

To study the bio chemistry of Noctiluca we might apply the various reagents and stains to determine the nature of the structures of the animal. Thus, osmic acid, as we saw, stains the fat globules ebony black. Methyl green, which Carnoy calls the "touchstone" of nuclein will reveal the fragmental pieces of the nucleus to be composed of the nuclein of Meyen. There are other reagents that will show the reticulum to be composed of plastin and the cuticle of elastin. From a large number of Noctiluca, collected in bulk, we could extract several soluble frements such as diastase and pepsin. Though we have not given as complete a study of this wonderful phosphorescent animal as we might have

desired, still we hope that we have said enough about its ordinary characteristics to show that it deserves more than usual attention in courses of cytology.

Notes on the Priority of Certain Plant Names.

J. A. Nieuwland.

Having had occasion to examine some volumes of early botany by authors whose several works came out shortly after the publication of the Species Plantarum of Linnaeus, 1st Ed. 1753, I found that there are a number of genera restored earlier than the dates usually quoted in some of our common texts. As the older botanists made it a rule to restore the earlier names that Linnaeus suppressed rather than create new ones, they are nearly always unanimous in the choice of the names applied to any particular restored genus. Hitherto most of the following restorations have been credited to Adanson, 1763,* but I find that these authors have anticipated him in many cases. I shall quote only the title of the book, the writer's name, and the date of publication of the volumes referred to.

Duhamel du Monceau. Traite des Arbres et Arbustes, 1755. Also the German edition of the above: 1762, 1763.

Hill, J. British Herbal, 1756.

Shaw, T. Travels and Observations Relating to Several Parts of the Levant. (In the end of the book.) Collectanea, Specimen Phytographiae Africanae, 2nd Ed. 1757.

Ludwig, C. G. Definitiones Plantarum, 3rd Ed. (by Boehmer,) 1760.

Morandi, J. B. Historia Plantarum Practica, 2nd Ed. 1761.

The following are some of the genera and species restored. I shall give the dates when available and indicate at the end of each item the hitherto accepted names, authors, and dates.

1. Persicaria, Hill, 1756, instead of Persicaria, Adanson, 1763.
   Also Persicaria, Shaw, 1757.
   Persicaria, Morandi, 1761.

Thus the publication of Adanson was preceded also by that of both Shaw and Morandi. The genus has been recognized as separate from the Linnaean aggregate Polygonum. Bistorta, another of the Polygonum segregates was also restored by Morandi

* Adanson, M. Familles des Plantes, 1763.

under the above date. This was preceded however, by the publication of the same by Hill, 1756, as was pointed out by Dr. Greene.*

2. Helianthemum, Shaw, 1757, instead of Helianthemum, Persoon, 1807.

Also Helianthemum, Ludwig, 1760, and Morandi, before that of Persoon.†

3. Pulsatilla, Hill, 1756, instead of Adanson, 1763.

Also Pulsatilla, Morandi, 1760, before that of Adanson.

4. Fagopyrum, Hill, 1756, instead Fagopyrum, Gaertner, 1791.

Also Fagopyrum, Ludwig, 1760, before that of Gaertner, but only in part, as Ludwig's genus includes Bilderdyckia, since segregated from the Linnaean aggregate Polygonum.

Also Fagopyrum, Morandi 1761, before that of Gaertner.

Hill has the oldest specific binary not a duplicate. This is noted for the benefit of those botanists that do not accept such names as Fagopyrum Fagopyrum, that seem to have become so popular of late.

Fagopyrum vulgare, Hill, 1756, instead of
Fagopyrum esculentum, Moench, 1794, or
Fagopyrum Fagopyrum, (Linn.) Karsten.

5. Abutilon, Hill, 1756, instead of Abutilon, Gaertner, 1791.

Hill also has the oldest binary name for the species hitherto called Abutilon Indicum.

Abutilon album, Hill, 1756.
(Sida Indica, Linn. 1763.)

6. Tithymalus, Duhamel 1755, instead of Tithymalus, Adanson, 1763. Hill, Shaw, and Morandi restored the name before Adanson.

7. Phalangium, Hill, 1756, instead of Adanson, 1763. Morandi also restored the genus before Adanson.

8. Colocasia, Morandi, 1761, instead of Schott. Linnaeus had suppressed the genus and put the plant under Arum, as Arum Colocasia, Linn. 1753.

9. Argentina, lately recognized as separate from the Linnaean aggregate of Potentilla, and having as its type, Potentilla Anserina, Linn. was separated by Hill, 1756, and the genus is to be attributed to him and not to Lamarck. The plant was called by Hill, Argen-

* Greene, E. L. Leaflets of Botanical Observation and Criticism, I, p. 18.

† Gray's Manual 7th Ed. 1908.

tina vulgaris. The name does not hold for the species owing to the priority of the Linnaean specific.

10. Padus, is of late again coming to be recognized as a genus distinct from Prunus. It includes the Choke-Cherries and is to be attributed to P. Miller, and not to Borckhausen.

11. Toxicodendron, Poison Oak or Poison Ivy, has been recognized as a valid segregate from the Linnaean Rhus, and has been attributed to P. Miller.* Duhamel had restored it.

Toxicodendron, Duhamel, 1755.

12. Xylosteon or Xylosteum, a segregate from the Lonicera Linn. is also to be attributed to Duhamel, 1755, instead of B. Jussieu, 1789.

13. Hypopitys, Hill, 1756, instead of Adanson, 1763.

Also Hypopitys, Ludwig, 1760, before that of Adanson.

14. Cymbalaria, Hill, 1756, instead of Medicus, 1791.

15. Abies, Duhamel, 1755, instead of Jussieu, or of Hill, 1756.† The genus has hitherto been attributed to P. Miller, 1768.

16. Alnus, Duhamel, 1755, instead of Hill, 1756, or Gaertner, 1791.

17. Larix, Duhamel, 1755, instead of Adanson, 1763.

18. Malus, Duhamel, 1755, instead of Jussieu, 1789 or Hill, 1756.

19. Arisarum, Hill, 1756, instead of Kunth and Schott.

20. Dracunculus, Morandi, 1761, instead of Schott, 1832.

21. Unifolium, Ludwig, Boehmer, 1760, instead of Adanson, 1763.

22. Taraxacum, Ludwig, Boehmer, 1760, instead of Haller, 1768, but only in part.

23. Bursa, Ludwig, Boehmer, 1760, instead of Wiggers, (or Weber) 1780.

24. Onagra, Ludwig, Boehmer, 1760, instead of Adanson, 1763.

25. Chamaenerion, Ludwig, Boehmer 1760, instead of Adanson, 1763.

It may also be of interest that Morandi, 1761, Ludwig, 1760, and Hill, 1756, restored the old name Polygonatum, thus relegating the Salomonia, Heister, 1763, to synonymy.

26. Cotinus, Duhamel, 1755, instead of Cotinus, Adanson, 1763. Hill also gives the oldest binary name not a double binary,

* Greene, E. L. Leaflets etc., I, p. 114. (1905.)

† Gray's Manual, 7th Ed. (1908.)

Cotinus coriaria. This name was first applied to the plant as early as 1583 by Dodonaeus.

Cotinus, Duhamel, 1755.

Cotinus coriaria, Duhamel, 1755, instead of
(Cotinus Cotinus,) or
(Rhus Cotinus, Linn. 1753.)

27. Diervilla, Duhamel, instead of Moench, 1794.

28. The evergreen Padus, called by the older botanists Laurocerasus, was segregated by Duhamel, 1755, before it was done by Reichenbach.

29. Duhamel separated the aggregate of the Cherries and the Choke-Cherries from the Linnaean Prunus, under the name Cerasus. Small separated the Choke-Cherries from the Linnaean aggregate Prunus under the name Padus, leaving the Cherries in Prunus, and attributed the genus to Borckhausen.* Probably as fair a way out of the difficulty, if such there be, would be to accept the three separate genera as P. Miller, had done. Cerasus is as much entitled to generic standing as Laurocerasus, if not more so, the latter being little more than an evergreen Padus.

Though none have ever confused Prunus and Cerasus by calling them all Plums, or all Cherries, Padus and Cerasus have together been called and are called Cherries.

30. For those mycologists that accept no names prior to 1753, the name Lycogala, first applied to the plant by Micheli, 1729, should be attributed to Adanson, 1763,† who preceded Persoon, and Roemer, in the restoration of the name.

Lycogala, Adanson, 1763, instead of Persoon, Roemer.
(Lycogala, Micheli.)
(Lycogala, Persoon, Roemer.)

It may be interesting in this connection to know that the herbaceous Cornels, Cornus Canadensis, and Cornus Suecica, lately recogaized in the rank of a genus by Rydberg,‡ under the new name Cornella, were first restored to the rank of a genus by Hill, 1756, this author protesting at the same time vigorously against the method of aggregating genera practised by Linnaeus. Hill chooses the oldest of names for the plants, one impossible of acceptance under the Linnaean laws of nomenclature.§ Hill's name is Chamaepericlymenum. Though Chamaepericlymenum Canadense and Chamaepericlymenum Suecicum are not as harsh

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* Small, J. K. Flora of the S. E. United States, 1903.

† Adanson, M. Familles des Plantes, (1763) vol. 2.

‡ Rydberg, P. A. Flora of Colorada, 1906.

§ Linnaeus, C. Philosophia Botanica, 1st Ed. (1751) pp. 197-198.

in pronunciation as a great number of other accepted names, this is no argument for their acceptance. Mycologists do not seem to be scrupulous about the acceptance of polysyllabic words, as is evident from the fact that such words as Dictydiaethalium, Rost 1873,* are taken without comment. It is to be regretted that Rudbeck's name,† Mesomora, was not chosen by Rydberg, all the more for the reason that Linnaeus quoted this very example of Mesomora in his Philosophia Botanica,‡ in laying down the rules for the authors after him that would find it desirable to break up his aggregate genera into their originals. That after the publication of the Species Plantarum, 1753, the so-called "starting point" in nomenclature, he had not changed his mind about this is evident from the fact that the second edition of the Philosophia Botanica‡ contains the same statement. The Rudbeckian name is of course, like Chamaepericlymenum pre-Linnaean, but it has been the custom of nearly all the post-Linnaean botanists to restore the old names to their segregates from Linnaeus' genera.

Hydrodictyon A Synonym.

The publication of Hydrodictyon, Roth, 1800, a name for the alga commonly called the Water-net, was preceded by the publication of Adanson's name Reticula in 1763. It is true that Adanson made the blunder of including a fungus in the genus, probably because of his ignorance of the true nature of the plant quoted from Micheli.§ The fact that the creating of the genus was made in a group of algae seems to show that he had primarily in view the plant first referred to as the Conferva reticulata of Dillenius,‖ and so called also by Linnaeus.** Adanson has an unmistakable description, and this taken together with the reference to the description and plate of Dillenius makes the publication conclusive, though some will object to the reference of Micheli, and reject Adanson's name in spite of the law of priority

Reticula, Adanson, 1763, instead of Hydrodictyon, Roth, 1800.

Dasiphora, A Synonym.

The Shrubby Cinquefoil having as a type the Linnaean plant,

* MacBride, T. North American Slime Moulds, 1899.
Cooke, M. C. Myxomycetes of Great Britian, 1877.

† Rudbeck, O. F. Lapp. 98. (1701) ex. Linn. Fl. Suec, (1745).

‡ Linnaeus, C. Philosophia Botanica, 2nd Ed. (1755) pp. 197-198.

§ Michelius, P. A. Nova Plantarum Genera, (1729) pp. 125, Tab. 66.

‖ Dillenius, J. J. Historia Muscorum, (1741) p. 20, Tab. IV, No 14.

** Linnaeus, C. Species Plantarum, (1753) p. 1165.

Potentilla fruticosa, has been recognized as a valid genus under Rafinesque's name Dasiphora.* Duhamel had, however, separated it from Potentilla, Linn. 1753, under the old name Pentaphylloides. Both Linnaeus and Duhamel to the History of Robert Morison, who first described the plant, and studying the description of the plant by Duhamel together with his references, and that of Rafin esque, the publication of Pentaphylloides is incontrovertible.

Pentaphylloides, Duhamel, 1755.

(Dasiphora, Raf.)

I herewith indicate the generic priority but, since names ending in oides are objectionable in the Linnaean code, and have until lately been rejected, I leave it to others to transfer the specific,

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Tentative List of the Birds of St. Joseph Co., Ind. and Vicinity.

B. ALPHONSUS.

As the result of some years of observation I have obtained the following list of birds of this locality. Only such are given as have actually been found here by the writer, and though the list is not as yet complete, yet it has the advantage of being as far as it goes, authoritative and authentic. Transients and visitors are either excluded, or noted as such. Though it may be interesting to note accidental bird visitors to our country, I wish especially to make a record of such birds as actually nest and make their home in our neighborhood.

Some of the accidental visitations of birds are quite remarkable. An example of the kind was furnished only a few months ago, when a farmer, not far from Notre Dame, authentically was reported to have killed a Bald-headed Eagle that attempted to get away with some of his fowl. Gulls too are frequent visitors to our inland lakes, but they never remain longer than a few days. Birds that spend only a short time in our locality need not, of course, be reported here.

The scientific names of birds as commonly accepted are given first and the common English names appended. This list forms

* Rydberg, P. A. Flora of Colorada, 1906.

only a partial summary of a larger work on the birds of the county prepared by the writer, but not as yet published.

ABBREVIATION.

S. V.—Spring Visitant.
W. V.—Winter Visitant.
S. R.—Summer Resident.
F. S.—Four Seasons.
W. R.—Winter Resident.

Megascops asio	Screech Owl, F. S.
Coccyzus erythrophthalmus	Black-billed Cuckoo, S. R.
Coccyzus americanus	Yellow-billed Cuckoo, S. R.
Ceryle alcyon	Belted Kingfisher, S. R.
Dryobates villosus	Hairy Woodpecker, S. V.
Sphyrapicus varius	Yellow-bellied Sapsucker, S. V
Melanerpes erythrocephalus	Red-headed Woodpecker, S. R.
Colaptes auratus	Flicker, S. R.
Antrostomus vociferus	Whip-poor-will, S. R.
Choetura pelagica	Chimney Swift, S. R.
Trochilus colubris	Ruby-throated Hummingbird, S. R.
Tyrannus carolinensis (Tyrannus tyrannus)	Kingbird, S. R.
Myiarchus crinitus	Great-crested Flycatcher, S. R.
Sayornis phoebe	Phoebe, S. R.
Contopus virens	Wood Pewee, S. R.
Cyanocitta cristata	Blue Jay, F. S.
Corvus americanus	Crow, F. S.
Dolichonyx oryzivorus	Bobolink, S. R.
Molothrus ater	Cowbird, S. R.
Agelaius phœniceus	Red-winged Blackbird, S. R.
Sturnella magna	Meadowlark, S. R.
Icterus spurius	Orchard Oriole, S. R.
Icterus galbula	Baltimore Oriole, S. R.
Quiscalus purpurea (Quiscalus quiscula)	Purple Grackle, S. R.
Carpodacus purpureus	Purple Finch, S. V.
Loxia curvirostra minor	Red Crossbill, S. V.
Spinus tristio	American Goldfinch, S. R.
Plectrophenax nivalis	Snow Bunting, W. V.
Spizella pusilla	Field Sparrow, S. R.
Pooceetesa gramineus	Vesper Sparrow, S. R.

Ammodramus savannarum passerinus	Grasshopper Sparrow, S. R.
Spizella socialis	Chippy, S. R.
Junco hyemalis	Snowbird, W. R.
Melospiza fasciata	Song Sparrow, S. R.
Pepilo erythrophthalmus	Towhee, S. R.
Cardinalis virginianus (Cardinalis cardinalis)	Cardinal, S. R.
Habia ludoviciana	Rose-breasted Grosbeak, S. R.
Passerina cyanea	Indigo-Bird, S. R.
Chelidon erythrogaster	Barn Swallow, S. R.
Piranga erythromelas	Scarlet Tanager, S. R.
Ampelis cedrorum	Cedarbird, S. R.
Vireo olivaceus	Red-eyed Vireo, S. R.
Vireo gilvus	Warbling Vireo, S. R.
Certhia familiaris americana	Brown Creeper, W. R.
Dendroica aestiva	Yellow Warbler, S. R.
Dendroica blackberniae	Blackbernian Warbler, S. V.
Miniotilta varia	Black and White Warbler, S. V.
Protonotaria citrea	Prothonotary Warbler, S. R.
Geothlypis trichas	Northern Yellow-throat, S. R.
Galeoscoptes carolinensis	Catbird, S. R.
Herporhyncus rufus	Brown Thrush, S. R.
Troglodytes aedon	House Wren, S. R.
Litta carolinensis	White-breasted Nuthatch, F. S.
Parus alricapillus	Chickadee, F. S.
Regulus satrapa	Golden-crowned Kinglet, S. V.
Regulus calendula	Ruby-crowned Kinglet, S. V.
Turdus mustelinus	Wood Thrush, S. R.
Merula migratoria	Robin, S. R.
Sialia sialis	Bluebird, S. R.
Columbigallina passerina terrestris	Morning Dove, S. R.
Chordeilles virginianus	Nighthawk, S. R.
Botaurus lentiginosus	American Bittern, S. R.
Progne subis	Purple Martin, S. R.
Colinus virginianus	Bobwhite, F. S.
Empidonax traillii alnorum	Alder Flycatcher, S. R.
Falco sparverius	Sparrow Hawk, S. R.
Buteo lineatus	Chicken Hawk, S. R.
Podilymbus podiceps	Hell Diver, S. R.
Aegialitis vocifera	Killdeer, S. R.
Turdus aonalaschkae pallasii	Hermit Thrush, S. V.

Lanius ludovicianus	Loggerhead Shrike, S. R.
Setophaga ruticilla	American Redstart, S. R.
Actitis macularia	Spotted Sandpipper, S. R.
Zonotrichia leucophrys	White-crowned Sparrow, S. V.
Totanus flavipes	Yellow-legs, S. R.

(To be Continued.)

Teratological Notes.

I. An Abnormal Specimen of Taraxacum.

A. M. Kirsch

In the spring of 1895 there appeared on the lawn in front of the University of Notre Dame some peculiar specimens of common Dandelion, (Taraxacum officinale, Weber.), one of the most remarkable of them is still kept in the herbarium of the Botanical Department. A photograph of this plant was taken at the time of collecting and a copy of this is here reproduced. The plants, about 35 to 40 in number, came up from a particularly well manured plot some twenty-five feet square and were found in patches of three or four plants not far from a large clump of shrubs of Philadelphus coronarius, Linn, 1753, on the extreme northeastern corner of the University Quadrangle. They were so conspicuous by their size and proportions that they attracted immediate attention.

Every one of the thirty-five or forty plants was more or less abnormal by the growing together of from three to ten scapes topped by the same number of perfect sessile heads. The one here illustrated was, however, particularly remarkable in this respect as it consisted of a cluster of from sixteen to eighteen heads sessile on the top of a large hollow scape nearly one and one half inches in diameter formed by the coalescing of the individual scapes of the separate heads. The compound hollow scape was fluted or rather ridged, of almost uniform diameter throughout and tomentose-pubescent all along its length of about five inches. The individual heads were closely aggregated on a broad hemi spherical expansion at the top of the scape, the whole cluster of heads being about three inches in diameter. Each head had its own separate involucres. The large scape arose from the center of the rosette of leaves, ordinary in outline, size, and general appearance. From the base and surrounding the large scape

PLATE III.

AN ABNORMAL SPECIMEN OF TARAXACUM OFFICINALE, WEBER.

there arose about twenty-four ordinary single headed dandelion scapes perfectly normal in every respect.

The following year the plants were to a large extent again abnormal but the aggregates of heads were not as large as the preceding year, and were fewer in number. In succeeding years the phenomenon was not noticed as the lawn was kept closely cropped and special efforts made to eradicate all the dandelions, as the plant had by this time become quite a nuisance hereabouts.

Owing to the fact that the spring was moist and warm and the locality was more than ordinarily manured in fall there is little doubt that the peculiar state of the plants was due to extra ordinary conditions of nutrition. The specimen collected was as is evident from the plate very young and had not even attained to maturity in bloom. All the scapes were as yet brown in color due to the fact that chlorophyl in the scape and involucre had not developed. Specimens of plants with two or three heads on a scape are quite common but specimens like the one described are quite rare. Plants outside the small patch scattered over the rest of the lawn were to all appearances quite normal.

Microscopy Notes.

I. Simple Method of Easily Resolving Microscopical Test-Objects.

A. M. Kirsch.

Even the amateur microscopist has come to recognize that the value of a microscopical objective depends on the ease with which it will resolve with perfect clearness certain test objects usually diatoms with delicate markings. One of the most difficult of these diatoms as a test is Amphipleura pellucida Kg. the striae of which number about 96,000 to the inch. It is claimed that a good one-twelfth inch immersion lens will bring out these delicate lines to the vision, but the writer has tried this with a number of such objectives under the various directions usually given, but always with very doubtful if any success. In experimenting for a long time with various objectives it was found that the fault lies not with the objectives, nor with the mounting medium usually balsam, but rather with the method of illumination of the test object.

Abbe has shown that by transmitted light diffraction images are obtained and refraction images by reflected light. Not to enter into a discussion of these different images it suffices to say that the author had spent hours at a time trying to catch a glimpse of the striae and invariably failed, until one day a lucky accident brought them to view. On this occasion while working near a window through which the direct sunlight happened to strike the top of the stage of the microscope, a sudden accidental movement so placed the stand as to exclude the light from the mirror. The direct sunlight fell on the edges of the drop of immersion oil and immediately the markings came out clearly, sharply, and unmistakably. After a certain amount of experimentation it was found that the best results were obtained when the incidence of the direct sunlight took place as nearly as possible parallel to the stage, the microscope being inclined for the purpose, and at right angles to the striae. From this it would seem that the lines are alternate ridges and depressions on the diatom shell and the lines were brought out as contrasts of ridges with their shadows. The method is so easy and simple that the merest beginner in microscopy could bring out the markings without any difficulty. The method has been used with great advantage in our laboratories in determining the markings on the spores of the Myxomycetes, as this characteristic is at times an important factor in the determination of these plants.

Notes on Histological Technique.

I. A SIMPLIFIED MODIFICATION IN A STAINING METHOD.

J. HUERKAMP.

The usual method of staining plant tissues with Delafield's haemtoxylin and saffranine as described in the common texts of histology and microtechnique, requires that the preparation remain in the latter stain about 12 hours in order that sufficient and satisfactory penetration of the color may result. Tissues of certain plants will take the stain much more rapidly and retain it more tenaciously, while others even after being kept in the stain longer than is ordinarily required can not be made to keep it at all.

It is well known that saffranine, like many of the so-called aniline dyes, is intensified in the presence of alkalies, and weakened or entirely removed in the presence of acids. Advantage is made of this fact in the following modification of the method used in our laboratory for a long time. The time needed for the preparation of slides is very much shortened and the results are quite as satisfactory in regard to the quality of the microscopical slides.

Sections of plant tissue to be double-stained with Delafield's haematoxylin and saffranine after being attached to the slide with albumen fixative, are slightly warmed and the paraffine removed with xylol, and the xylol, with alcohol in the usual way. The alcohol is removed by immersion in water, and the preparation over-stained with the haematoxylin. Excess of stain as also the cloudiness and muddiness is removed by washing for a second or more as is found necessary, in dilute hydrochloric acid.

When the proper reduction of the color has been obtained the acid is rapidly removed by washing in water, and the slide may immediately be stained with saffranine, which need not be allowed to act more than a minute or two, and often less. Penetration of the color is further insured by putting the slide in ordinary tap-water which removes the excess of stain and fixes it into the preparation, because of the traces of alkali usually present in ordinary water. Distilled water is therefore undesirable in washing off stains. After removal from the water, which may be done almost immediately, the preparation will be found to be over-stained, and the excess of red color may be taken out by washing with 95 per cent alcohol to which a small amount of slaked lime has been added. This alkali is but very slightly soluble in alcohol,* yet sufficiently so to cause the further fixation of the red in the desirable parts of the tissue, and the removal of the same from the other parts already stained with the haematoxylin. Wood tissue and nucleus will take up the saffranine, and the cellulose remain blue or purple-blue with the haematoxylin. If the red does not come out as quickly as desired, alcohol without any alkali may be used in washing.

The preparation of microscopic slides by the process described is so rapid that the slides may be made by the dozen at a time, in a few minutes, and the preparation of a single slide does not take much longer than it does to describe the above method. If saffranine is used before the haematoxylin the results do not seem to be as easily obtained as by the procedure outlined.

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* About 3 milligrams or calcium hydroxide of slaked lime has, by experiment been found to dissolve in 100 cc. of absolute alcohol, or less than 1 gram in 30,000 parts by volume of alcohol. The solubility increases, however, in proportion to the general amount of water present, but in 95 per cent alcohol it is still very small.

ERRATA.

P. 2, L. 14. For "fully represented" read "feebly represented."

P. 9, L. 7. For "Bütchli" read "Bütschli."

L. 8 from bottom For "Gigioli" read "Giglioli."

P. 13, L. 15. For "Notciluca" read "Noctiluca."

P. 14, L 17. For "hetter" read "better."

P. 19, L. 12 from bottom. For "recogaized" read "recognized."

P. 21, L. 4. After "Duhamel" insert "refer."

P. 22, L. 4 from bottom. For "tristio" read "tristis."

Last line. For "Poocteesa" read "Pooecetes."

P. 23, L. 6. For "Pepilo" read "Pipilo."

L. 18. For "blackberniae" read "blackburniae."

L. 19. For "Miniotilta" read "Mniotilta."

L. 23. For "Herporhyncus" read "Harporhyncus"

L. 25. For "Litta" read "Sitta."

L. 26. For "alricapillus" read "atricapillus."

L. 32. For "Morning" read "Mourning."

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Fresh Water Sponges and Particularly Those of the United States.

A. M. Kirsch.

In the beginner's class of Zoology there is invariably noticed a doubting expression of surprise when it is announced that the next subject to study is the Fresh Water Sponge. I fancy I can see the same expression on the face of those of my readers who may doubt that sponges are found in the nearby brook, river or lake. To be sure, such sponges as the average man knows about, and which he can buy in the nearby drug store, are not to be looked for in our ponds and ditches; they must be sought in the far away Mediterranean Sea or down on the coasts of the Bahamas or on the Keys south of Florida.

There are many kinds of sponges — just as there are many kinds of roses or violets. This comparison reminds me also of the necessity of stating that sponges are not vegetable growths, as was once believed even by all the scientists and is still believed by many otherwise well educated people. It was in the middle of the 19th Century that it became definitely settled that sponges belong to the animal kingdom. They are now very often placed by themselves into a proper phylum called Porifera though some had placed them formerly with the Protozoa as compound Choanoflagellata, and many at present associate them with the phylum Coelenterata. Very little attention is to be paid at present to the various systems of classifications in vogue. They are all transient and provisional, and this is the most annoying condition of Zoology to the beginner. He takes up one text-book after another and he finds in each a different system of classification: and it is wise in the part of the teacher to show him from the beginning, that classification of animals is not after all the important

* June 15, 1909.—Pages 29 to 60.

work of the Zoologist, the important thing in a man's library is not where his books are placed—provided he knows what they contain. It would be loss of time for me to enter here upon a discussion of the various systems of classification with reference to the Porifera, whether it should be natural or artificial; phylogenetic or morphological is of no consequence for the moment. Those of my readers that want this kind of thing can find it in the classical works of Bowerbank, Oscar Schmidt, Zittel, Gray, Carter, Hæckel and Vosmaer. For my part I believe that Professor James Hornell, of the Jersey Marine Biological Station, has chosen the form of classification best adapted to my purpose: In Vol. I., No. 2, February, 1894, of "The Journal of Marine Zoology and Microscopy" page 39, he formulated the following system:

PHYLUM:—PORIFERA.

Branch A, *Calcarea*
Family I.—Asconidae.
" II.—Syconidae.
" III.—Leuconidae.
(Characterized respectively by the Canal system indicated by the name.)

Branch B, *Non-Calcarea*
Class I.—(Skeleton siliceous) Silicispongiae.
Order I.—Monaxonida.
" II.—Tetractinellida.
" III.—Hexactinellida.
Class II.—(Skeleton fibrous) Ceratosa.
Class III.—(Skeleton none) Myxospongiae.

The Calcarea are recognized by the chemical composition of their so-called skeleton. This skeleton is in the form of needles and spines of various forms, but invariably their animal matter is highly or almost completely impregnated with calcium carbonate, and can easily be verified by subjecting them to any mineral acid, which will disolve them with effervescence. They are all marine and therefore do not concern us in this study.

The non-Calcarea include, as may be seen from the table above, three kinds or classes. In the first class are included all sponges that have spicules of a siliceous or glassy composition. In the second, we find those sponges whose skeleton consists of a horny fibrous network, (sponge of commerce), and the third class includes those that have no skeleton and wholly consist of soft animal matter.

The reader will notice that the siliceous sponges are sub-divided into three orders and these orders are again based on the form of the spicules. In the first order the glassy needles are simple rods or needles. In the second the spicules consist of four needles

radiating from one point and in the third order the radiating needles are six. Now comes the all important question in this study. Where shall we place the Fresh Water Sponges? If we follow Hornell's classification the question is simple. In all Fresh Water Sponges the spicules are siliceous and of the monaxial type, and so they must belong to the class of Silicispongiae and to the order of Monaxonida.

Vosmaer places the Fresh Water Sponges into the third order of the Non-Calcarea which he calls Cornacuspongiae; and he gives the following diagnosis: "Skelet besteht entweder aus, vorwiegend, monaxilen Spicula, welche durch mehr oder weniger spongin zusammengekittet sind, oder nur aus spongin mit oder ohne Vestärkung von Fremdkörpern. Leben in See,—brackischem und Süss-wasser meist nicht sehr tief." Translated this means that in the Cornacuspongiae "the skeleton consists principally of monaxial spicules which are cemented together more or less by spongin, or the skeleton consists merely of spongin with or without strenghtening of foreign bodies. They are found in salt water—brackish water—or in fresh water and not at great depths." Thus we see that Vosmaer places the Fresh-Water Sponges in the same group as the ordinary commercial sponges which are all marine; he however separates them from each other by creating two sub-orders viz.: the *Halichondrina*, in which the fresh-water sponges are found forming the second family called Spongillidae, and the *Ceratina* which include the commercial sponges as Family two, viz.: Spongidae.

I need scarcely say here that the prospective student will find no difficulty whatever in identifying the Fresh Water Sponges. Fresh Water Sponges properly so called are only found, as a matter of fact, in fresh water, all other sponges are found in the sea, and so whenever a sponge grows in fresh water one need have no fear of making a mistake as to identity. Let this be the guide for the beginner and after he has found a few Fresh-Water Sponges and studied them with the low power or high power of the compound microscope he will gain the knowledge to distinguish them from marine forms. There are difficulties in the study. There are so many things growing in fresh water, but one should not be discouraged, for the matter is not as difficult as it seems. First one must get over the idea that everything green in the water must be a plant—an alga or some moss. The former one will at once reject when one sees that it consists of simple or branching green threads and the latter has small green leaves which even one-inch hand lens will make plain. All one needs in the field is a hand lens of one inch

focus and one cannot go wrong. Of course, the first question naturally is: "Where shall I look for them, and how can I tell when I have found a Fresh Water Sponge?"

One will soon find that many of the troubles are imaginary ones, as to my own surprise I found them more readily than I had expected, and having found them, I knew they were what I was looking for in spite of the difficulties I had anticipated.

It was in the middle of September many years ago that I set out for the banks of the St. Joseph River in Northern Indiana. The banks were steep and some old stumps of trees were scattered along the shore, with their twisted roots reaching out in all directions. I soon noticed in the swift current that on some of the roots were greenish looking tufts—I secured a few of them, and hardly had I touched them, when I knew I had found what I had been looking for. The sponge mass is not the same as Cladophora. One will know it at once and will never forget it. Under the hand lens one will see the little needle-like spicules sticking out in all directions, but more than this in the interior of the mass one notices the small round globules, so characteristic of the Fresh Water Sponges. These globules are the gemmules and whenever these small globules are found in a greenish mass one may be sure that the specimen is a sponge. It is needless to look for sponges in the spring time, but one will never fail to find them later in the year and especially in August and September.

These gemmules are bodies peculiar to Fresh Water Sponges, and have never been found in salt water forms. They are known in the literature of sponges as: Ovaria, gemmules, statoblasts, statospheres, sphaerules, etc., but at present the term "gemmules" is mostly used. I stated above that one must look for greenish masses, but this must not be taken to mean that the color is always green; the fact is they are often brown, gray and white according as they are more or less exposed to the light. Though a few have been found in muddy localities, they must, however, as a rule be sought in clear, pure and rapidly running water. A favorite locality is in shallow water of rivers, and they grow on loose stones, but one seldom fails to find them on rocks, timber, or loose boards at the end of a mill race or fall, or on the lining board and casings of sluice-ways. They should never be looked for in shallow waters that have a muddy bottom.

Sometimes they may be found on plants growing in lakes and they will spread over these plants like a thick cobweb or cushion. A long pole with a scraper attached to the end in connection with

a bag made of netting can be used advantagously in bringing them up from timber as piles driven into the rivers near dams etc. Sometimes a mill race is emptied for repairs or a reservoir of water works for the purpose of cleaning, and then is the time to search for sponges among the rocks and timber.

Always collect them preferably from timber as they can more easily be removed by slicing off chips or splinters and they are secured without too much injury. The gemmules which are deep within will not be lost.

Young sponges such as are collected late in Spring or early in Summer will not have gemmules and, although useful to collect at all seasons, yet if for the purpose of determining the genus and species they must be collected not earlier than July. If the student's purpose is only to gather them as a collector, then he may transfer them directly into 50 per cent. alcohol or better 35 per cent. and when he gets home after some hours transfer them to stronger alcohol. Others may be placed in shady places to dry, and to prevent decay, they should be turned over at short intervals. In no case should they be left in water for any length of time as they will rapidly decay. If one wishes to study their life action they must be transferred as quickly as possible to shallow glass dishes. To demonstrate the circulation of water through the sponge mass a solution of carmine is made in pure water. After having placed the fresh living sponge into a suitable dish and covered well with water a small amount of the carmine solution is taken up with the pipette and gently emptied over one part of the sponge—soon the carmine colored water will be seen to disappear into the mass drawn in by a suction movement, and shortly after the carmine colored water will be seen to be ejected like diminutive clouds from minute chimney-like structures. This circulation is caused by the flagellated cells that line the canals in the mass. One can also watch the development of the gemmules by securing eight or ten of them and place them in a shallow watch glass with water, and cover them with a piece of glass to prevent evaporation—should this take place to some extent, one can easily add with a pipette very gently some pure water. The watch glass is placed near a window not too much lighted, and in a few days the growth can be examined under a compound microscope with a three-quarter inch lens, or with a water immersion lens of a higher power.

The student may take some of the fresh material and place a bit of it on a slide and examine it, but he will find that a bit of thoroughly dried material mounted directly into Canada balsam

will prove more satisfactory. If he has the conveniences of a biological laboratory at his disposal, he will want to make sections, and this does not present difficulties that would prove unsurmountable. A bit of the alcohol specimen may be stained with borax carmine and imbedded in celloidin and good sections may be made with an old microtome blade. The siliceous or glassy spicules will certainly spoil somewhat his best knife, but then in every laboratory there are a few knives reserved for just such kind of work. I have even made fair free hand sections of the gemmules, that will show the arrangement of the birotulate spicules which form the rather thick wall of these objects.

In examining a bit of sponge under the microscope, we will at once notice two structures viz., the skeleton part and the sarcode or fleshy part. The fleshy portion is supported by a siliceous framework made up of fine delicate, needle-like spicules—these spicules are about one-hundredth of an inch in length and pointed at both ends as a rule; in some species the spicules will be found to be covered by minute pointed projections and giving them a thorny appearance. The shape, size and appearance of these spicules help to determine the species. Besides these skeletal spicules there are others somewhat different in appearance and they are found in the dermal layer and hence called "dermal spicules." In the walls of the gemmules are found a third kind of spicules called "birotulates," these are somewhat of the shape of dumb-bells, but the ends instead of being knobs are either circular disks, or toothed disks or even a circle of kooklets. These birotulates are very important in classification. Carter selected them as the basis for the diagnosis of the genera of Spongillidae.

In order to determine the genus and species of any Fresh Water Sponge, there should be made four microscopic preparations:

The first is to examine a small piece of the dried sponge mounted directly in balsam.

The second is a similar preparation of the dermal portion to study shape and form, presence or absence of dermal spicules.

The third preparation consists of the gemmules for examination both in their normal state and in a cleared preparation. This latter preparation is made by placing a mass containing eight or ten gemmules on a slide and applying some hot nitric acid to it—this will remove most of the sarcode. Care is to be taken not to leave the acid too long as it will also attack the chitin of the spicules. After the acid has acted for a time, it may be washed out a number of times by applying alcohol and then absolute alcohol, xylol and finally mount in balsam.

The fourth and last preparation needed is easily made and it is done by the general method of cleaning diatoms --polycystina or sponge spicules. Take a test tube and put into it some of the material, add some nitric acid and boil gently over flame. After the material is completely disintegrated add water to fill the test tube, and set aside for an hour and the spicules will settle to the bottom, where they will form a sediment. Pour off carefully or with a long pipette, remove the water without disturbing the sediment. Wash thus several times to remove acid, alcohol may be used the third time as it hastens the next process.

Take with a pipette a small quantity of the sediment and place a drop of it on the middle of a clean slide. Let it ary completely and pass the slide through a flame. Finally put on the balsam and cover and you have a permanent preparation of all kinds of spicules contained in the sponge.

There remains for me only to note here all the species that have been so far observed in North America, I shall enumerate first all the genera so far observed in the whole world, secondly, I shall give the number of species belonging to each genus, and mention all the North American species in each genus. An abreviated and slightly modified key to the Genera of Fresh Water Sponges according to Potts–Carter System may be stated as follows:

A Fresh Water Sponges with gemmules.

I. Gemmules with arotulate spicules.

1. Gemmules surrounded by simple thorned spicules which are pointed or rounded at ends. . SPONGILLA.

II. Gemmules with birotulate spicules.

1. Birotulate spicules of one class or type and rotules equal or nearly so. . . . . MEYENIA.
2. Birotulate spicules of two classes or types—the smaller number of them longer and rotules hooked. HETEROMEYENIA.
3. Birotulate spicules with rotules unequal. . TUBELLA.

III. Gemmules with unirotulate spicules.

1. Spicules forming capsule of gemmules with only one rotule other end merely pointed. . . . . PARMULA.

IV. Birotulate spicules of no consequence. The foraminal tubules of the gemmules more or less prolonged and terminating in a funnel-like expansion or divided into thread-like appendages varying in length and number. . . . . CARTERIUS.

B. Fresh Water Sponges in which gemmules have not been found.

Provisionally there are three genera:

Uruguaya, *Lubomirskia* and *Potamolepis.*

Of these nine genera of Fresh Water Sponges the following five are represented in North America: Spongilla, Meyenia, Heteromeyenia, Tubella, and Carterius.

Parmula with three species has thus far only been reported from South America.

Uruguaya with one species is reported from the rapids of the River Uruguay, near the town of Salto.

Lubomirskia with four species has only been reported from Lake Baikal, Central Asia.

Potamolepis with three species has only been reported from the Congo River, Africa.

We may now proceed to the study of the North American species of the five remaining genera.

I. Genus *Spongilla* Lamarck, 1815.

It is well known that the ancient authors placed all the Fresh Water Sponges into the genus Spongilla, and Mr. Potts claims that Carter is the founder of the genus as it stands to-day; he says on page 182 of his Monograph, "When the old genus *Spongilla* of authors was subdivided by Mr. Carter in 1881, this term was very appropriately restricted to that type which includes the species most widely diffused and most frequently noticed throughout the world." Therefore the genus may read:

Genus, *Spongilla*, Carter. 1881.

Under this genus Potts enumerates 17 species some of which exhibit varieties.

Among these species five are North American, viz.:

1. *S. aspinosa.* Potts.
   Loc. New Jersey swamps.
2. *S. lacustris.* Linn. Widely known as the commonest F. W. Sponge. He gives the following varities: *paupercula*, *lawsoni*, *abortiva*, *montana*, *multiforis and lehighensis.*
3. *S. fragilis*, Leidy. This is reported from many localities in U. S. A., and it has many varieties. One variety called calumeti; Thomas, is reported from the Calumet River, near Chicago.
4. *S. mackayi*, Carter, from Nova Scotia.
5. *S. terrae-novae*, Potts, from Newfoundland.

II. Genus, *Meyenia*, Carter, 1881.

This genus includes 17 species not counting a number of varieties. Seven of the species are North American.

1. *M. leidyi*, Carter, so far only found at Philadelphia and in New Jersey.
2. *M. fluviatilis*, (*Spongilla fluviatilis*, of authors) found in all parts of U. S. and in many varities.
3. *M. robusta*, Potts, from California.
4. *M. millsii*, Potts, from Florida.
5. *M. subdivisa*, Potts, from Florida.
6. *M. baileyi*, Bowerbank. West Point, N. Y.
7. *M. crateriformis*, Potts. Pennsylvania.
8. *M. everettii*, Mills. Gilder Pond, Mt. Everett, Mass.

III. Genus, *Heteromeyenia*, Potts, 1881.

In this genus Potts enumerates four species with a few varieties, all of which are only so far reported from the U. S. A.

1. *H. repens*, Potts, reported from Lehigh Gap, Pa., Lake Hopatcong, New Jersey, and along the Eastern Coast.
2. *H. argyrosperma*, Potts, from Lehigh Gap, Pa., New Jersey, and New England States.
3. *H. longistylis*, Mills. Sponge unknown but gemmules collected by Dr. Wolle at Bethlehem, Pa.
4. *H. ryderi*, Potts. This sponge is reported from Florida to Nova Scotia and from Atlantic Coast to Iowa. I found it in St. Joseph River, Indiana.

IV. Genus. *Tubella*, Carter, 1881.

In this genus, we find five species, one of which is represented in U. S. A. The other four being found in the Amazon River of South America.

1. *T. pennsylvanica*, Potts. It is found in Lehigh River and generally throughout Eastern U. S.

V. Genus, *Carterius*, Potts 1881.

This genus contains four species, three of which are found in the United States of America. The fourth being found in Russia and in Bohemia, but Carter claims that the Russian species is identical with species *C. tenosperma* of America.

The American species are:

1. *C. tubisperma*, (?) Mills, and was found on timber in the Niagara River, N. Y., and also in a reservoir in Boston, Mass.

2. *C. latitenta*, (!) Potts, found in Chester Creek, Pa., and in Western New York.
3. *C. tenosperma*, (!) Potts. First found by Mr. Potts in a rill at the Centennial Fair Grounds, Philadelphia, and later in New Jersey.

In conclusion let me state that the principal object in writing this communication for the Midland Naturalist is to stimulate students in its territory in the study of Fresh Water Sponges; I would like to see all localities in its territory where any of the species are found, reported in these pages.

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Carter, History and Classification of the known species of Spongilla, 1881.

Potts. Fresh Water Sponges, A Monograph. Proceeddings of Academy of Natural Sciences, Philadelphia, 1887. This Monograph is indispensable for the study of American Fresh Water Sponges.

It covers the whole ground of Fresh Water Sponges and gives special facilities for the determination of all American species as far as known.

Vosmaer, Klassen und Ordnungen der Spongien. (Porifera) 2nd vol. of Bronn's, Klassen und Ordnungen des Thier-Reichs.

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Tentative List of Myxomycetes of Northern Indiana and Southern Michigan.

L. Barbazette.

The following list of the Myxomycetes of northern Indiana and southern Michigan represents only part of those actually observed in this locality, and only those species are mentioned which are at present found in the herbarium of the University. They were collected by Dr. J. A. Nieuwland of the botanical department of Notre Dame University, during the months of July and August in the year 1905. Favorable conditions for growth, warm weather followed by periodical rains, were prevalent at that time and many of the plants that were developed then have not been seen since.

Continued drought is extremely destructive to Myxomycetes as we had ample opportunity to observe last year. During 1909 not more than a dozen species were found in the same region and they were of the commonest kinds. These seem to develop under almost ordinary conditions. Among the few common slime-moulds that appeared last season are *Trichia varia*, *Arcyria denudata*, *Hemitrichia stipitata*, and *rubiformis*, *Fuligo ovata*, and *Lycogala epidendrum*. All of these developed in places that seem to produce such plants independently of periodic showers, as the localities are always moist, e. g. wet shady woods. Even *Fuligo ovata* was very scarce last season.

Whether the drought of 1908 will cause a larger crop of Myxomycetes to appear this coming season if rains are favorable remains to be seen. Many species that failed to develop may appear this year. In fact it was noticed that several forms are appearing unusually abundant and very early. *Lycogala epidendrum* one of the few that were found in 1908 was seen this year in a dry location on the University grounds in the interval of several warm days between two snow storms and this in spite of the fact that the season is very much backward. Two crops of the plants appeared about April 13 and April 20. The last crop coming out between two falls of snow. Snow enough to cover the ground appeared twice in fact since the last date. The plants were perfectly normal and healthy in spite of the cold. Some were fixed in chrom-acetic acid for later study while still in the plasmodial stage.

In 1905 Myxomycetes were found very abundantly in woods and fields free from trees, and even in marshes. A plasmodium of *Fuligo ovata* over a foot and a half square was found crawling over oak leaves which had been dumped into a marsh. The same plant was found coming up from the middle of a cinder-path in several places. Its presence here was quite puzzling until it was investigated. It was found to have come up from an oak stump under several inches of cinders through which the Fuligo crept to develop. Only a hundred yards away the same species was found on a dead poplar seven feet from the ground. Physarum cinereum usually appearing annually on the grass in the University lawn has for years taken at each reappearance the forms and configurations of the "fairy circles" of certain Basidiomycetes.

The words "common," "abundant;" etc., refer to the fact that other species were observed abundantly in nearby localities but duplicates were only collected from places at least two miles apart.

Arcyria pomiformis (Leers) Rost. 1875.
Found at Bankson Lake,
near Lawton, Mich., July 27, 1905

Arcyria incarnata Pers. 1791.
At Bankson Lake, July 25, 1905.

Arcyria ferruginea Sauter, 1841.
At Bankson Lake.
Very common. July 25, 1905.

Arcyria denudata (Linn.) Sheldon. 1895.
In Studebaker's Woods,
South Bend, Ind. July 10, 1905.
Also Bankson Lake.
Quite Common. July 27, 1905.

Arcyria digitata (Schw.) Rost. 1875.
Woods at end of Prairie
Ave., South Bend, Ind. July 10, 1905.
Also Bankson Lake. July 27, 1905.
Very Common and
abundant.

Arcyria cinerea (Bull.) Pers. 1801.
At Bankson Lake. July 27, 1905.
Also Studebakers's Woods. July 10, 1905.
Very common and
abundant everywhere.

Arcyria nutans (Bull.) Grev. 1824.
North of Bankson
Lake. Common. July 27, 1905.

Badhamia rubiginosa (Chev.) Rost. 1876.
At Bankson Lake. July 27, 1905.

Cribraria minutissima Schweinitz. 1832.
At Bankson Lake. July 27, 1905.
Also Studebaker's Woods.
Common but hard to find. July 10, 1905.

Cribraria dictydioides Cke. and Balf. 1881.
At St. José Park, Bankson
Lake. Very common. July 24, 1905.

Cribraria purpurea Schrad. 1797.
At Bankson Lake.
Very Common. July 25, 1905.

Cribraria splendens (Schrad.) Pers. 1801.
At Bankson Lake. July 27, 1905.

Ceratiomyxa fruticulosa (Muell.) Macbr. 1899.
In Studebaker's Woods.
Common everywhere. July 10, 1905.

Craterium leucocephalum (Pers.) Ditmar, 1813.
In Studebaker's Woods. July 10, 1905.
Also Bankson Lake. July 27, 1905.

Comatricha irregularis Rex. 1891.
In Studebaker's Woods. July 10, 1905.
Also Bankson Lake. July 27, 1905.

Cienkowskia reticulata (Alb. and Schw.) Rost. 1873.
At St Joseph River
Portage near Notre
Dame, Ind. Rare. Aug. 1905.

Diderma testaceum (Schrad.) Pers. 1801.
At Joseph River Portage.
Quite Common. Aug. 1905.

Diderma floriforme (Bull.) Pers. 1794.
At Bankson Lake. July 27, 1905.

Diderma niveum (Rost.) Macbr. 1899.
In Ravine near St. Mary's
Academy, Notre Dame, Ind. Aug. 1905.

Diderma globosum Pers. 1794.
In Ravine near St. Mary's
Academy. Quite common. Aug. 1905.

Diderma crustaceum Peck. 1871.
In Ravine near St. Mary's
Academy. Aug. 1905.

Diderma cinereum Morgan. 1894.
At Bankson Lake. July 25, 1905.
Also near St. Mary's
Academy. Aug. 1905.

Diderma spumarioides Fries. 1829.
In ravine near St. Mary's
Academy. Aug. 1905.

Diachea leucopoda (Bull.) Rost. 1875.
At Bankson Lake. July 27, 1905.

Didymium xanthopus (Ditm.) Fries. 1829.
At Bankson Lake. July 27th, 1905.

Didymium clavus (Alb. and Schw.) Rabenhorst. 1844.
In Woods along Sumption
Prairie Road, South Bend, Ind. July 10, 1905.

Didymium squamulosum (Alb. and Schw.) Fries. 1829.
In Studebaker's Woods. July 10, 1905.

Dictydium cancellatum (Batsch) Macbr. 1899.
In Studebaker's Woods. July 10, 1905.
Also at Bankson Lake. July 27, 1905.

Dictydium cancellatum var. purpureum (Batsch) Macbr. 1899.
At Bankson Lake.
Very abundant. July 25, 1905.

Enteridium splendens Morgan. 1899.
On Sumption Prairie Road. July 10, 1905.

Fuligo ovata (Schaeff.) Macbr. 1899.
Near St. Joseph's Lake,
Notre Dame, Ind.
Common everywhere and
abundant throughout the season. June to Sept. 1905.

Hemitrichia clavata (Pers.) Rost. 1873.
In Woods south of
Sumption Prairie Road.
Common everywhere. July 10, 1905.

Hemitrichia serpula (Scop.) Rost. 1875.
At St. Joseph River
Portage. Rare. Aug. 1905.

Hemitrichia stipitata Mass. 1889.
At Bankson Lake.
Quite common. July 27, 1905.

Hemitrichia vesparium (Batsch) Macbr. 1899.
On Sumption Prairie
Road. Quite common. July 10, 1905.

Lycogala epidendrum Fries. 1829.
At Bankson Lake.
Also Studebaker's Woods.
Common everywhere. July 10, 1905.

Leocarpus fragilis (Dickson) Rost. 1875.
In Studebaker's Woods. July 10, 1905.

Lamproderma arcyrionema Rost. 1875.
In woods along Sumption
Prairie Road. July 10, 1905.

Mucilago spongiosa (Leyss.) Morgan 1897.
At Bankson Lake. July 27, 1905.

Physarum cinereum (Batsch) Pers. 1801.
University Lawn. July, 1905.

Physarum leucopus Link. 1809.
Near St. Mary's
Academy. Aug. 1905.

Physarum sinuosum (Bull.) Weimn. 1828.
At Bankson Lake. July 27, 1905.
Also at St. Mary's Academy. Aug. 1905.
Also at St. Joseph River Portage. Aug. 1905.

Physarum plumbeum Fries. 1829.
At Bankson Lake. July 25, 1905.

Physarum pulcherrimum Berk. and Rav. 1873.
At Bankson Lake. July 27, 1905.

Physarum ellipsosporum Rost. 1875.
Near St. Mary's Academy. Aug. 1905.

Reticularia lycoperdon Bull. 1791.
On Sumption Prairie Road.
Quite common. July 10, 1905.

Stemonitis fusca (Roth) Rost, 1875.
At Bankson Lake. July 27, 1905.
Also Stukebaker's Woods.
Very Common.

Stemonitis maxima Schweinitz. 1834.
At Bankson Lake.
Common and abundant. July 27, 1905.

Tubifera Casparyi (Rost.) Macbr. 1899.
At Bankson Lake.
Rather Common and abundant. July 27, 1905.

Tilmadoche viridis (Bull.) Saccardo. 1880.
At Bankson Lake.
Common everywhere. July 24, 1905.

Tilmadoche compacta Wingate. 1889.
In Studebaker's Woods. July 10, 1905.

Trichia varia (Pers.) Rost. 1875.
Near St. Joseph River Portage. Aug. 1905.

Trichia persimilis Karst. 1868.
Near St. Joseph River Portage. Aug. 1905.

Department of Botany
University of Notre Dame

The Preparation of Absolute Alcohol for Histological and Chemical Purposes.*

ALBERT T. MERTES.

A cheap and convenient method of preparing absolute alcohol for histological purposes on a small scale in a school or college is much needed. The ordinary methods given in text-books of organic chemistry require a considerable amount of apparatus and many different appliances which an ordinary biological laboratory might not conveniently have, and it is because of this fact that the following method has been devised.

Ordinary commercial alcohol about 90 to 95 per cent. strong is placed in a bottle or flask and small quantities of calcium carbide added at different intervals of time dependant on the rapidity with which the carbide is attacked,—about once in six hours is sufficient; if the mixture be placed in a warm place, however, the action is much more rapid. 125 grams may be added at the beginning of the operation, and 25 grams at a time every 5 or 6 hours thereafter until the reaction is finished. This point may be recognized both by the cessation of the appearance of bubbles of acetylene, or from the fact that the freshly added carbide remains several hours unacted upon.

The carbide acts upon the water in the alcohol, forming slaked lime and acetylene. (Reaction) $CaC_2+2H_2O=Ca\ (OH)_2+C_2H_2$. When it is dehydrated the action ceases. During the process the mixture should not be shaken or agitated, because the slag or residue of slaked lime becomes suspended in the liquid and settles on the added portions of carbide thus preventing further action. If the carbide is added at different intervals it spreads out upon the spent residue forming a layer that will be acted upon.

When the last layer of carbide remains unchanged after being in contact with the alcohol for some hours, the action is considered complete. If much matter remains suspended in the liquid, the mixture is allowed to stand a little longer till the supernatant liquid is clear and well settled. The alcohol is now carefully decanted or siphoned into a dry bottle and kept therein until used.

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* Extract from thesis for the Bachelor's degree in Science. I wish to thank my professor, Dr. J. A. Nieuwland, who suggested the subject of this thesis.

Alcohol prepared in this manner is completely dehydrated but contains as an impurity acetylene gas, some lime in solution, also some traces of organic sulphur compounds. The alcohol though clear may be of a strong yellow color due to these compounds especially so when denatured alcohol is used. This color, however, is not objectionable when the primary end is to obtain an absolute alcohol for histological purposes. The acetylene may be almost entirely removed by warming the liquid to about 75° C. This may be easily accomplished by placing the bottle on a steam radiator for two or three hours till the heat drives the gas out of solution. The acetylene that remains does not affect the reagents nor mounts. The lime disolved is not appreciable, being about 1 part by weight in 30,000 of alcohol by volume. Though this alcohol is not strictly pure, the presence of lime is not deleterious, but on the contrary is beneficial. The alkali appears to fix the dye into the section to be stained so that the color of the tissue does not fade. The reason is that most of the dyes used in staining have basic properties and the color is intensified or made more permanent by an alkali, and the dissolved lime answers this purpose, as already noted. *

Where it is impracticable to use dehydrated alcohol containing lime or acetylene in solution, the alcohol may be further purified by subjecting it to distillation, thus getting rid of the dissolved impurities from the action of the commercial carbide which is rather impure. On account of the solubility of acetylene in alcohol there will be a small amount found in the distillate. This is removed by adding a little finely-powdered and dried silver and mercuric nitrate or mercuric oxide. These salts form compounds with the acetylene and on again subjecting the alcohol to distillation they are eliminated and the distillate is obtained pure and absolute. Mercuric oxide removes sulphur compounds which are liable to be present, since thioaldehydes are almost always formed as a result of the action of an acid on calcium carbide.

Pure absolute alcohol is described as absolutely odorless and the product prepared by this method comes as near to being as free from having any odor whatever, as any we have ever obtained by the methods hitherto described. This fact strongly emphasizes the purity of the alcohol made from carbide according to the directions we have given.

The essential reason why calcium carbide is more efficient for dehydrating purposes, than quicklime is that it acts upon the water

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* Midland Naturalist, Vol. 1, p. 28.

in two stages: $CaC_2 + H_2O = CaO + C_2H_2$; $CaO + H_2O = Ca(OH)_2$. In the first stage of the reaction acetylene and calcium oxide are formed; and the calcium oxide then unites with more water producing calcium hydroxide. Thus for every molecule of carbide used there are two molecules of water acted upon. Using ordinary unslaked lime we have an agent which is theoretically one-half as efficient as carbide and practically never even half as efficient, since its reaction is the same as the one taking place in the second stage when carbide is used, consequently it has the disadvantage of not being as active in uniting with water as is carbide, and since it absorbs a great deal of alcohol, thereby the distillation from the residue becomes very slow and incomplete.

In an experiment using two liters of alcohol having a specific gravity of .832 or about 90 per cent purity, we obtained 1400 cc impure alcohol such as could be used for dehydrating in methods of histological technique,—the only piece of apparatus used being an ordinary bottle containing the mixture. By distilling the residue or slag remaining after these 1400 cc of alcohol had been decanted, nearly 400 cc more of alcohol absolutely free from water was obtained, thus making the yield almost quantitative. To this distillate were added a few grams of dried mercuric nitrate and some silver nitrate. The mixture was then allowed to stand about a day in a warm place till all the acetylene and other compounds, which are formed due to the impurities in the carbide, were acted upon.

In order to be sure that all the acetylene has combined with the mercury and silver salts, some of the clear liquid was decanted and tested with a small portion of finely powered silver nitrate. Any precipitate or dark coloration which formed on standing indicated the presence of impurities, and necessitated the addition of more mercury and silver salts.

When all the impurities from the carbide were removed, the liquid, after decantation or filtration from the precipitate, was distilled and found to have a specific gravity of .7876 at 25° C. or a purity of 99.8 per cent. The distillate had hardly any odor or a very slight but pure ethereal one, and was practically free from any foreign substance whatever. It is always necessary to free the liquid from any of the precipitates of silver or mercury carbides formed by the action of the acetylene on the purifying salts, for there is danger of their exploding or decomposing when the last portions of the alcohol are distilled.[1]

It required several days to effect the dehydration, and 550 grams of calcium carbide was used. The dehydration may, how-

ever, be accomplished in a much shorter time by boiling with an excess of carbide on a water bath, and using a reflux condenser. Absolute alcohol was made by this latter process in 10 hours.

It was found that the final distillate measured 1600 cc or the yield was equivalent to 89 per cent. of the theory. A larger yield could have been obtained if greater care had been used in obtaining the last traces of alcohol from the slag in the distilling vessel. This yield is much greater than that obtained by any other method now in general use that we have tried, and the ease in which the dehydration is accomplished as well as its completeness, make the carbide method the best one that we have been able to find.

Migration of Birds in St. Joseph County, Ind., from March 1 to May 30, 1909.

B. Alphonsus.

The accompanying observations on the migration of birds was made at Notre Dame, Ind., and immediate vicinity, and unless otherwise stated the dates refer to their arrival.

The condition of the weather always affects the migration of birds northward. In a mild winter, the first arrivals appear here about the middle of February. In 1906, an exceedingly mild winter, I saw a flock of about a dozen robins on the 15th of February; on the 12th of the same month I saw a song sparrow. The full tide of migration, however, seldom sets in for any species before the 1st of March.

During this month a cold wave will check the coming of the birds, making their arrival a week or two later than usual. The same holds good in April. Birds that generally arrive in the last week of April, such as the catbird, purple martin and Baltimore oriole, may not appear until after the 5th of May.

The present spring was notable for cold weather. The first week in March and April the weather was comparatively warm. The remainder of these months it was cool and some days cold. In May up to the 21st the temperature was over 70° only three days. On eight days it was below 60°. The lowest temperature in May was 32° on the 1st of the month. In the evening snow covered the ground.

The dates of the arrival and the departure of birds given in this article were taken from my notebook. A list of all the birds found each day enabled me to know pretty accurately the day a bird was first or last seen.

March	1	Bluebird
"	2	Robin
"	5	Meadowlark
"	6	Song Sparrow
"	7	Purple Grackle
"	9	Killdeer
"	19	Mourning Dove
April	3	Kingfisher
"	3	Phoebe
"	5	Cowbird
"	5	Vesper Sparrow
"	5	Flicker
"	6	Field Sparrow
"	7	Golden-crowned Kinglet
"	10	Chipping Sparrow
"	11	Yellow-bellied Sapsucker
"	13	Hermit Thrush
"	14	Purple Finch
"	17	Brown Thrush
"	17	Towhee
"	19	Hell Diver
"	19	Barn Swallow
"	20	Red-headed Woodpecker
"	20	Red-winged Blackbird
"	20	Myrtle Warbler
"	20	Cardinal
"	22	Ruby-crowned Kinglet
"	23	House Wren
"	26	Yellow Palm Warbler
"	27	White-crowned Sparrow
"	27	Spotted Sandpiper
"	27	Yellow-bellied Sapsucker departed
May	1	Kentucky Warbler
"	3	Chimney Swift
"	3	Wilson's Thrush
"	4	Brown Creeper departed
"	5	Golden-crowned Kinglet departed
"	5	Purple Finch departed
"	5	Yellow Warbler
"	5	Baltimore Oriole
"	5	Rose-breasted Grosbeak
"	5	Indigo Bird
"	6	Warbling Vireo
"	6	Snowbird departed
"	7	Catbird
"	7	Orchard Oriole
"	8	Kingbird
"	9	Black-throated Blue Warbler
"	11	Goldfinch
"	11	Oven-bird
"	11	Northern Yellow-throat
"	12	Redstart
"	13	Bobolink
"	13	Purple Martin
"	13	Blackburnian Warbler
"	13	Hooded Warbler
"	15	Ruby-crowned Kinglet departed
"	19	Yellow Palm Warbler departed
"	19	Scarlet Tanager
"	19	Bay-breasted Warbler

May 19 Dickcissel
" 21 Myrtle Warbler departed
" 22 Least Flycatcher
" 24 Canadian Warbler
" 24 Tennesee Warbler
" 25 Alder Flycatcher
" 25 White-crowned Sparrow departed
May 27 Crested Flycatcher
" 27 Blue Grosbeak
" 27 Cedarbird
" 28 Wilson Warbler
" 28 Yellow-billed Cuckoo
" 29 Hermit Thrush de-departed

Notes on the Priority of Plant Names.

J. A. NIEUWLAND.

In the April number of this periodical* several names of plants were found to antedate in publication the year commonly recognized at the present time. It has since been found that still another author published or restored several of these genera at a date earlier even than that stated in the preceding number of the Midland Naturalist. This botanist is J. G. Zinn, and the work in which the plants were published is his "Catalogus Plantarum Horti Academici et Agri Göttingensis," printed at Göttingen in the year 1757.

The following are affected:

1. Taraxacum, Zinn, 1757 (In part), instead of Ludwig-Böhmer, 1760.†

2. Unifolium, Zinn, 1757, instead of Ludwig-Böhmer, 1760.

3. Coronopus, Zinn, 1757, instead of Ludwig-Böhmer, 1760.‡

4. Odontites, Zinn, 1757, instead of Ludwig-Böhmer, 1760.‡

5. The name Epipactis was stated by A. A. Eaton § to have been first used by Böhmer in Ludwig's 3rd Ed. of the Definitiones Plantarum, 1760. The name was, however, previously published by Zinn, 1757, to designate the aggregate of the Linnaean genus Serapias as limited by A. A. Eaton, and Epipactis proper formerly called Helleborine. Those that follow the rules underlying the "theory of residues" will probably therefore attribute the name to Zinn instead of Böhmer.

* Midland Naturalist, Vol. I., No. 1, p. 18.
† Ludwig, J. G. Definitiones Plantarum, 1760. 3rd Ed, by Böhmer.
‡ Gray's Manual, 7th Ed. 1908.
§ A. A. Eaton, Proc. Biol. Soc. Washington, XXI. (1903), pp. 63–68, also Repertorium Spec. Novar. F. Fedde, Vol. VI., p. 40–44.

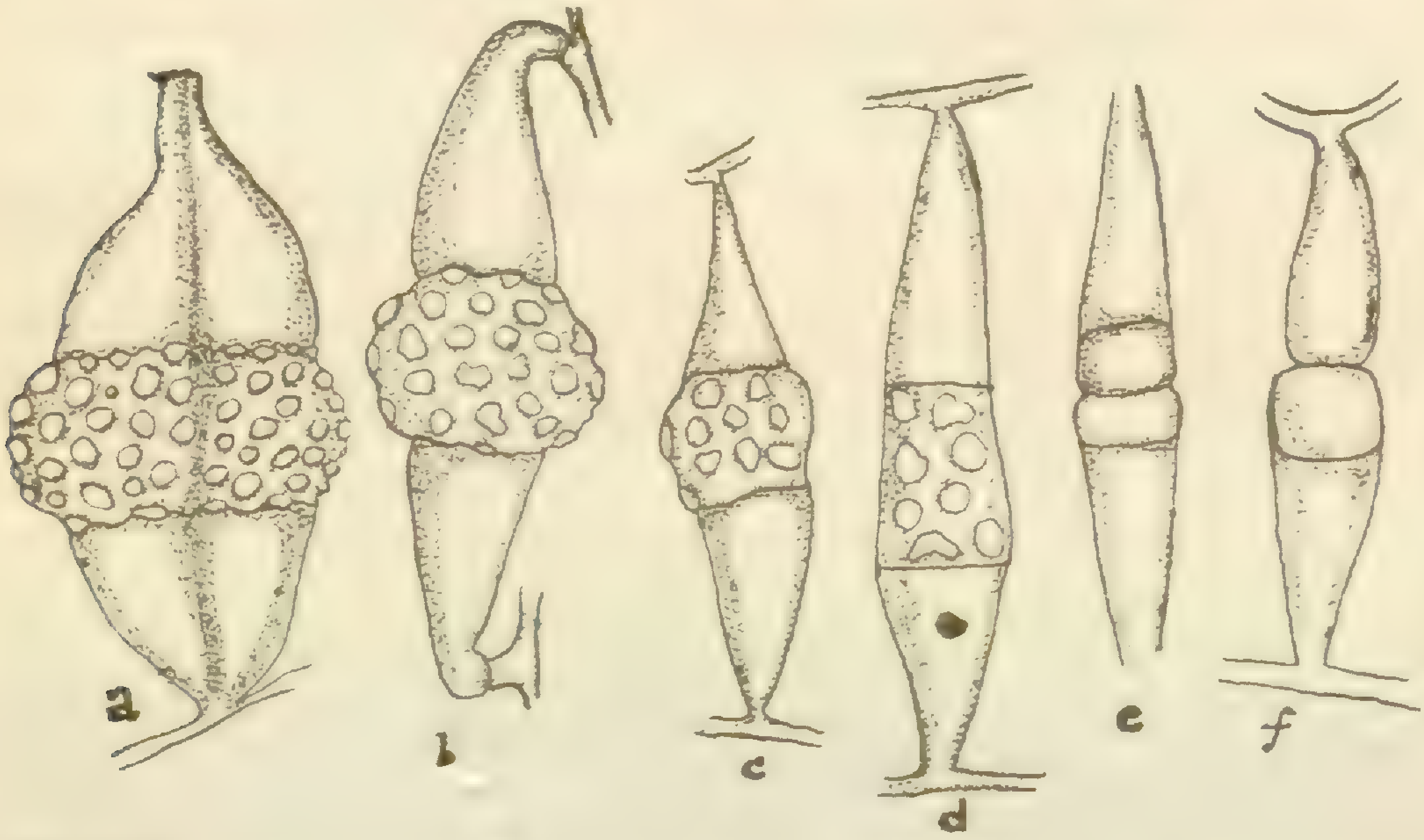
MO. BOT. GARDEN

Mycological Notes. *

GUY WEST WILSON.

I. ZYGOSPORES OF MUCOR STOLONIFER.

In the course of a series of cultures of various species of *Mucor* there was obtained a number of zygospores of *M. stolonifer* Ehrenb. (*Rhizopus nigricans* Ehrenb.) These appeared the latter part of April, in a stender dish culture on a decoction of rye bread. Except for size they were typical of the species; but measured only 80–90 μ, or about one-half the size usually recorded. Innoculations from this culture to bread were made with the results that a good growth of mycelium was formed and numerous gametes produced. From some cause, the nature of which was not determined, very few zygospores were produced, and these were none of them strictly normal. While no cytological study was made, a careful gross examination of the protoplasmic contents of both cultures was made. In the first culture the zygospores were completely opaque, black in appearance, and upon rupture of the epispore a very distinct oil drop was visible. In the second culture, even the apparently matured zygospores in addition to being smaller in size



* The observations upon which these notes are based were made while a student in the laboratory of Dr. J. C. Arthur at Purdue University, La Fayette, Ind.

were less opaque, dark chocolate-brown in color and with the tubercles clearly discernable in the unbroken epispore. The protoplasmic contents were sparse and the oil globules small and numerous. That these were not immature stages is shown by the fact that three or four weeks time produced no change in the culture.

A series of camera-lucida drawings were made of several of the abnormalities found in the culture. The typical zygospore of the species is subglobose and borne between a pair of almost equal suspensors which taper from the spore to the hyphae from which they arise and with which they are continuous. The zygospore represented at figure *b* is normal except in regard to the suspensors which are separated from their hyphae by septae and are sharply curved at the base. Figures *c* and *d* represent types of poorly developed zygospores both of which were very light brown and almost destitute of protoplasm. Figures *e* and *f* represent parthenospores. These are formed by a single gamete and are said to have the same function as the zygospores. The term "azygospore" is usually applied to these spores but with questionable propriety as, being formed without the union of gametes, either equal or unequal, they are certainly not entitled to be called zygospores. Moreover, the term azygospore is not used to designate similar structures among the zygosporic Algae, nor are equivalent spores among the oosporic Algae and Fungi referred to as "anoospores." Figure *e* represents both the gametes as having formed smooth, light colored spores, while in figure *f* but one spore was formed, the other progamete not even cutting off a gamete.

By far the most interesting of these abnormal spores is that illustrated in figure *a*. This spore has the appearance of being double in structure; but at no point were the suspensors entirely separated, although both suspensor and spore were deeply grooved. This abnormality may have been formed by the fusion of closely approximated gametes; or, as is to the mind of the author much more probable, we have here an example of fasciation in the moulds.

II. A Nematode in Hydrogera Kleinii.

While engaged in a study of the local species of *Mucorales* of Tippecanoe County, Indiana, a mass of horse dung which was covered with *Hydrogera Kleinii* (van Tiegh.) Kuntze, (*Pilobolus Kleinii* van Tiegh.) was brought into the laboratory the 16th of October. The sporangiophores averaged a centimeter in height and were of a bright yellow color. The spores were large (14–20 μ)

and filled with an abundance of yellowish, granular protoplasm. The mould was of a very healthy appearance and luxuriant growth yet all attempts to germinate the discharged spores failed. The material was set to one side and no further attention given it until the first week in February when it was placed in a moist chamber where a scant growth of mould occurred. The sporangiophores were about 0.5 cm. in height and appeared white to the naked eye. Under the microscope a faint orange tint was apparent. The spores were normal in size but very light in color.

On the 15th the culture was reexamined to note the difference between the earlier and the later sporangia of the same growth. Only a few sporangia remained. Instead of the usual beautiful crystalline objects they had much the appearance of a large *Aspergillus*. Under the microscope the majority of the sporangia appeared as distorted masses of spores without trace of the sporangial membrane or of the subsporangial swelling. A single specimen was still intact, yet the subsporangial swelling was convulsed by an internal disturbance so that its form was constantly changing. It soon burst, six small worms emerged, and the sporangium took upon itself the same appearance as the others. The spores of these infested sporangia were only about 2–4 μ in size, colorless and apparently empty. They also exhibited a decided tendency to arrange themselves in chains of one or two rows of spores—a characteristic which I have not noticed in the normal spores. After the mass of spores had been washed away the effect on the sporangiophore was apparent. In escaping the worms broke the walls of the subsporangial swelling in such a way as to prevent the discharge of the sporangium and to allow the swelling to collapse somewhat, leaving the apex of the sporangiophore club-shaped.

The worms were minute, colorless, about 25–39 μ thick and 600–800 μ long. Under a high magnifying power the internal structure appeared rather distinctly and the organs could be traced with considerable satisfaction. The worms are enclosed in a transparent, colorless perisarc from which the body is entirely free. Anteriorly the worm is blunt and rather rounded with a distinct gullet. Posteriorly the perisarc is produced into a long tapering point far beyond the pointed posterior extremity of the worm. In motion the perisarc is very perceptably wrinkled but the body of the worm has no such appearance.

In Coeman's * Monographie du Genre Pilobolus (p. 49–52), we find an account of the sporangiophores of *Pilolobus crystalinus*

*. Mem. Cour. l'Acad. roy. Belg. XXX. 1861.

and *P. oedipus* being infested by a Nematode which he called *Rhabditis terricola* Duj. The form according to Coemans, is common in decaying substances and not of rare occurrence in the above named species. He cites references to previous observations upon the subject by Persoon,† Currey,‡ and Ehrenberg§. Illustrations of the worm and its work supplement the text || and lead to the conclusion that the species under observation is identical with that studied by the older authors.

Material from this culture was sent to Dr. C. W. Stiles of the Public Health and Marine-Hospital Service for identification. He reported that only larvae could be found and as no adults developed after a considerable period of observation he concluded that the species was parasitic upon the horse.

The papers cited above contain a discussion as to the relation of the worm to the fungus but only conflicting conclusions are reached; nor have we any theory to advance to explain the occurrence of the worms within the sporangiophores of the mould.

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†. Obs. Myc. 1:77. 1796.
‡. Jour. Linn. Soc. London 1:166.
§. Kuntze and Schmidt, Myk. Hefte. 2:67. 1823.
||. Pl. 11. A 19, C, D.

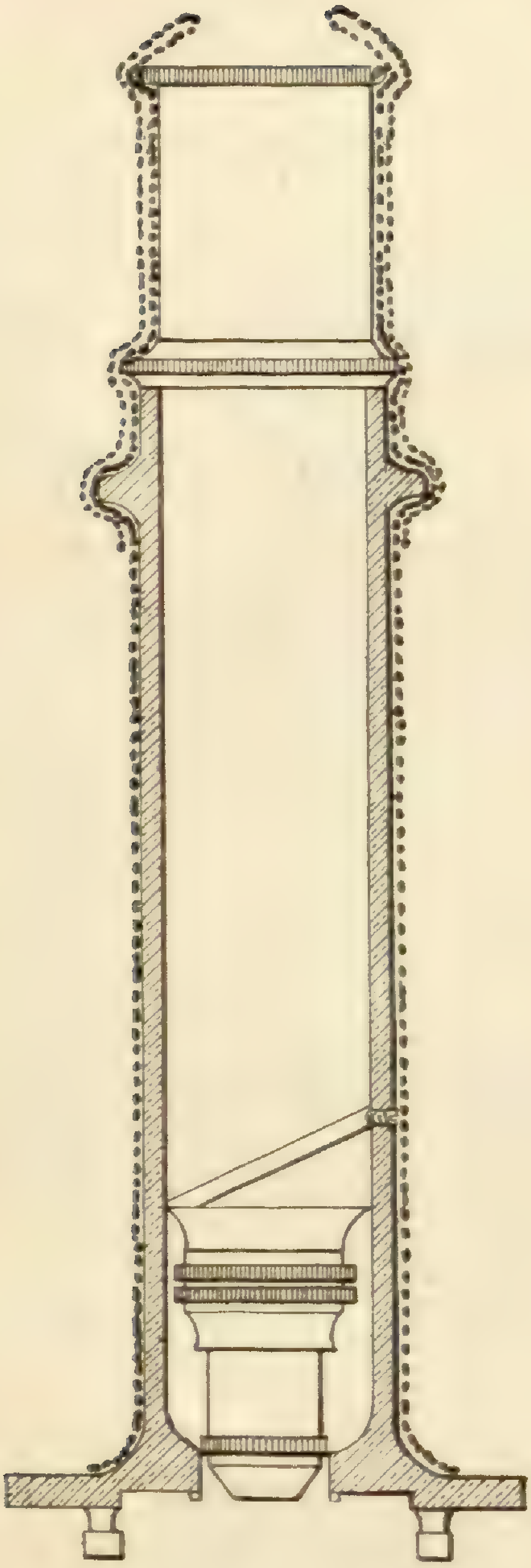
Microscopy Notes.

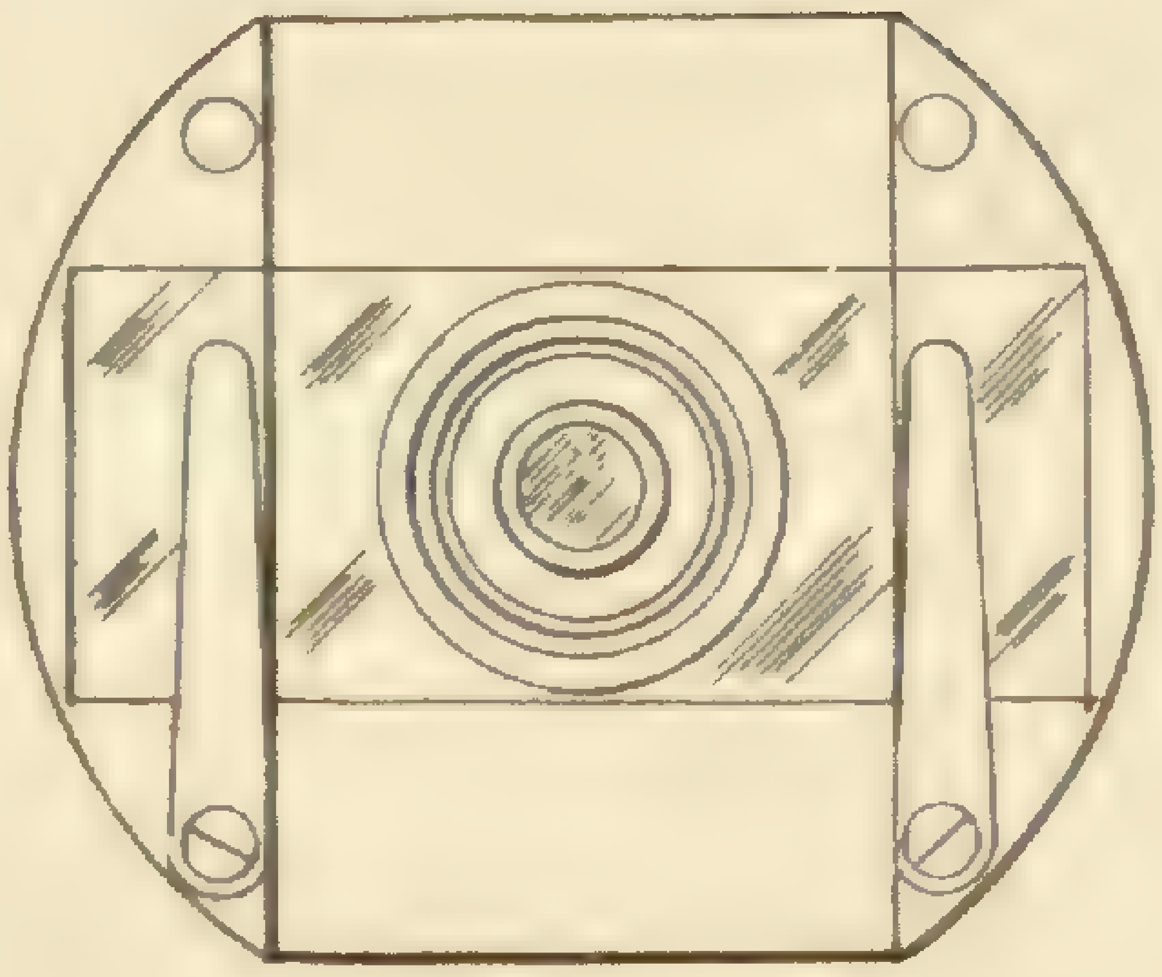
II. A Convenient Field Microscope.

By Joseph A. Martin.

The ordinary type of instrument advertised by optical companies, as a compound field microscope, such as designed to collect microscopic plants has many objections to its adoption for general use, especially because they are expensive and inconveniently constructed.

In gathering material or objects, such as algae, it is very essential for one to know whether or not the material is in favorable condition before leaving the field; for if left to be examined in the laboratory later and then found to be worthless loss of time results. On returning the following day it is not likely that one will find the





plants in the same stages of development, even after so short a time. An instrument then, that would have simple and effective workings would save much time and unnecessary trouble in gathering and examining or observing very minute objects. Then again, the best specimens of algae are oftentimes found where the ordinary field microscope, with its fittings so complicated, as though it were a laboratory instrument, is difficult to be used. It is really necessary that the different stages of plants be recognized before the collector leaves the field.

The accompanying illustration represents the contrivance one-half size, now used by the collectors of the University in gathering

and examining material in the field. This device is simply a modified demonstration microscope used in class examination of objects. The handle usually seen attached to the apparatus in the optical catalogues, is left off and the base is cut down to a narrow circular outline, so as to fit easily into the collector's pocket. A piece of Gooch tubing is stretched over the brass fittings of the instrument, to protect it from the corrosive action of the water and dirt. The ocular may be protected by a rubber cap and the objective is always kept from injury by the thick slide securely held by two clamps. The lenses most convenient are found to be either a two-thirds objective, with a wide aperture, and one inch or one-half inch ocular, or a one-half inch objective with a one inch ocular. Any higher power of objective combination than those indicated, was found difficult to focus, as there is no micrometer adjustment, and if one were present would be very inconvenient to work. A one-fourth inch objective was used but was discarded owing to the fact that it could not be rapidly brought to focus.

In making an examination, a small amount of the material is put on the outside of the slide, then held up to the light and by turning the tube may be focused. If a drop of water is examined for unicellular plants, the microscope may be held downwards to the reflection of the light of the sky from the water. A cover-glass is very desirable, though it is never really necessary except with unicellular forms.

Experience has shown that it is hardly ever necessary to use a combination higher than a two-thirds-inch objective, and a one-inch ocular. Such difficult material as conjugating desmids 13 to 15 microns in diameter were clearly and conclusively demonstrated with the combination just mentioned and this is about the smallest specimen likely to be gathered in ordinarily field work. The wider the aperture of the objective the better results will be attained, owing to the fact that the wide aperture takes in a broader field. The usefulness of the instrument as a demonstration microscope is not impaired in the least, and the handle can be replaced in a few moments. The type for field use is always kept nearly in focus by the Gooch tubing which is doubled on itself near the eye-piece to obviate wear on the milled parts of the microscope. Its simple construction makes it easy for students to use it with little danger or injury and all working parts are so thoroughly concealed that it is practically impossible for dust and dirt to penetrate.

Laboratory of Botanical Histology,
University of Notre Dame.

Book Reviews.

A New Booklet of Botany.*

Comparing this with other recent books on the same subject, one might with perhaps equal propriety designate it a Booklet of New Botany; there is so much of newness and originality in it, and this notwithstanding that the plants dealt with are for the most part old, and presumably well known.

The title, Elysium Marianum, is not a title of the condescending sort; that is to say, the unlettered will not know by the booklet's mere title, that it treats of plants, and is therefore a booklet of botany. Only the really educated and cultivated mind will readily infer that Elysium Marianum will prove a treatise on the delightsome woodland and meadow and park and wayside denizens of Maryland; and it is a new thing, almost, in modern botany, for an author to emphasize, in the title of his book, not the science itself, but rather, the exalted pleasure and refined delight which the pursuit of botany enkindles in the soul of every one who, having given both mind and soul much and careful culture, betakes himself to the study of plant life and form. All this, which the Latin title itself suggests, comes out clearly and explicitly, in English, in the brief Preface that introduces the first Part; and at the foot of these prefatory notes alone, by the way, and not on the title-page, does the author's name appear.

This introductory issue of the Elysium is of 96 pages supplemented by 12 fine plates. The first Part treats of the ferns and fern-allies of Maryland and Virginia; the second of the coniferous trees and shrubs of the same region. And while the title and the preface, as we have said, promise somewhat of the aesthetic in the treatment of things, yet this turns out to be something altogether different from, and in reality far above the merely popular account of the plants and trees taken under consideration. While giving in after paragraphs and elsewhere full expression to pleasing thought and lofty sentiment, the first thing everywhere is the accurate scientific account—the rigid morphologic diagnosis—of the plant or tree; the statement of the several marks by which the really

* Elysium Marianum, Washington, D. C., Part I, 1907; Part II., 1908. [Ivar Tidestrom.]

trained botanist may identify to a certainty the genus and species; and then its Latin name—its universally received scientific name—is given; all this quite as in the most dry and exclusively technical of books. Just this dry diagnosis, however, is one of the prime necessities of a good book of botany; that is, of botany that is not meant for the unbotanical, but for botanists. Let not this be overlooked. But still, it is not needful that a booklet about plants should both begin and end with mere plant description; and Mr. Tidestrom most happily demonstrates this; and it is in the demonstration of it that the ELYSIUM excels—and very far excels—all ordinary and familiar books in which plants are described.

For an example, let us review the Elysium's presentation of *Adiantum pedatum*, one of the most admired of North American ferns, as well as one of the most familiar among them; a plant commonly known to the unbotanical among us as the Maidenhair Fern.

The topic is introduced by the Graeco-Latin or scientific plant-name ADIANTUM; and this quite as one finds it in any and every book of systematic botany. It is the name of the genus—that is, of the whole assemblage of the so-called maidenhair ferns. Now printed on the same line with this name ADIANTUM in almost all books of scientific botany one reads an L. or the abbreviation Linn., which is always understood to signify that Linnaeus, the most noted botanist of the eighteenth century, founded this genus ADIANTUM and gave it that name. Our author declines to write either L. or Linn. after this generic name, but puts there the abbreviation Theophr. instead. And only to the uninstructed will this substitution of Theophr. in place of the conventional Linn., or L., seem a small matter. But any real master of botanical science at once perceives here the author's claim that not Linnaeus but Theophrastus is author of the generic name ADIANTUM. Theophrastus, the father of scientic botany taught publicly, and wrote an immortal treatise on it some 250 years before the Christian era. In that he has an account of the genus adiantum, and under that selfsame name. The upshot of all this is, that not only is Linnaeus not to be credited with adiantum; the genus was so known and so written upon by all botanists during all of two thousand years before him. To Mr. Tidestrom's mind evidently to credit Linnaeus with ADIANTUM is to intercalate a children's fable into the midst of a page of science, and that not *as a fable*, but as if it were the truth. The scientific mind—the mind that is in love with science—is in love with the truth, and naturally demands of science that it shall

in its every written page, and paragraph, and period, conform to the truth. Not one falsehood, which he has found to be such, can be admitted to his page. No ecumenical conclave of the world's botanical authorities, by their vote favoring falsities, can receive from the botanical truth-lover a moment's consideration. Though almost all the botanical books of the last hundred years assert that Linnaeus founded the genus ADIANTUM, and almost all botanical authorities of to-day will anathematize the daring man who eliminates from his booklet that and all falsehoods like it, the truth-lover—who alone is the truly scientific man—writes down the truth, spurning the untruth however often reiterated and almost superstitiously venerated. ADIANTUM, the fern genus, dates not from Linnaeus and 1753, but from Theophrastus Eresius, who ended a glorious botanical career just about twenty centuries before Linnaeus was born. It ought to seem—perhaps a few centuries hence, if not even a few score years from now it may seem—to have been a strange condition of things, that in the beginning of the twentieth century the falsifying of the history of plant-genera, and of plant names, should have been so almost universally practiced and approved, as virtually to bring maledictions on the head of any botanist who, knowing and respecting the truth about such matters, should dare however quietly and unostentatiously to promulgate it.

To have devoted so many paragraphs to this typical example of generic nomenclature in the booklet before us requires no apology. The whole subject is, and for years has been, too prominently before the botanical systematists of every land. And I am the more cogently impelled to a clear setting forth of the opinions of this writer by the fact that ostensibly, in the meditation of these supposedly intricate questions he has come out into the open daylight—has reached an advanced point attained by few—where no need is realized of so-called codes, the labored product of associations and congresses who seem to but scratch over the mere surface of the whole question, and deal with matters of present expediency to the utter ignoring of eternal principles. Mr. Tidestrom's position on generic nomenclature refreshingly recalls that one expressed by the late Professor H. Baillon of Paris, when he said that the only principle of nomenclature worth any consideration is that of historic priority: a principle which every conclave of botanical nomenclators that has met in recent years has voted to ignore.

Books of descriptive botany, even the conventional and the mediocre, are apt to give parenthetically after each Latin- or Greek-made generic name, some explanation real or supposed of the names

meaning; but these etymologies, commonly but guessed at—or more commonly pirated from some other author—are often most improbable, and not rarely absurd or ridiculous. Of these failings of hasty and slip-shod botanical etymologists the author of the Elysium is well aware. Also the explanations, where he produces them, are found worthy of a better than parenthetic placing; and he presents them not in his own language, but precisely that of the author who made the name; and this not only as a matter of scholarly discretion, but in justice to authors themselves; for the writer of the Elysium seems to hold piracies in abhorrence. Here is the classic explanation that he reproduces for the classic Greek ADIANTUM: "*Adianton autem ex eo dicitur, quod folium, ut Theophrastus ait, non madescat: Dodonaeus*, 1583. Stirp Hist. 466. There is in these reproduced etymologies no condescension to modern botanical illiteracy. He will not turn them into English. The even half equipped botanical taxonomist, even of this twentieth century, knows Latin. So also if the founder of a genus has explained the name of it in French, in German, or in Italian, the author of the Elysium does not translate it. He means his booklet for the tolerably well educated only.

Passing over the formal diagnosis of genus and species and this bibliography of the latter, all of which are accurate, yet also brief, as they should be, we present in its entirety the concluding Adiantum paragraph. It occupies about as much space as all the onomastic and diagnostic paragraphs combined.

"The leaves of *A Capillus Veneris* have been used in medicine from time immemorial; they are known in pharmacy as *Herba Capillorum Veneris s. Folia Capilli*, and were used in making a syrup (*Syrupus Capillorum*)."

This appears to me to be Mr. Tidestrom's own writing, and relates to the more southerly of the American species of genus; but the following he has taken from another author.

"*Adiantum pedatum* (see Linn. Spec. p. 1095) was also one of the plants in which a flourishing trade is carried on by Canada. Cornut in his Canadens. Plant. Hist. p. 7, calls it *Adiantum Americanum*; it is also described and illustrated on page 6. In Canada the plant is usually called *Herba capillaris* and *Maidenhaire* by the English in their colonies. It grows in abundance in all the Englishe provinces through which I have journeyed. It is just as frequent in Southern Canada, but I have never observed it about Quebec. It thrives especially in shady forests and rather rich soil. Several people in Albany and in Canada told me that its [leaves]

were much used instead of tea against consumption, coughs and all diseases of the lungs. They have learnt this from the savages who have used this for these purposes from time immemorial. . . . . The savages went about in the woods in great numbers, journeying for above Montreal searching for this plant."

Translated from Kalm's Res. Nor. Am. 3: 338. 1761.†

There are twenty other genera each of which might as well have been selected for comment as this classic one called *Adiantum*. A glance at any one of them reveals a character and quality in this booklet that make it, at least for this present time, unique, also praiseworthy beyond all that we have tried to say; and the botanists are, after all, perhaps not few, who will eagerly expect the future instalments of a primer of local botany that is so accurate, so simply honest and true in every detail, and withal so erudite.

EDWARD L. GREENE,

† Elys. pp. 27, 28.

CARTERIUS BOTH A SYNONYME AND HOMONYME.—A. M. KIRSCH.

Since the article on Fresh Water Sponges was sent to the press, it has been found that apart from the fact that the name, *Carterius*, Potts, 1887, is a homonyme, it does not even enjoy priority, as is evident from the following dates of *publication*. The specific name of several sponges of the genus must be changed according to all reasonable rules of nomenclature. When Potts changed the homonyme, *Carterella* to *Carterius* he made "confusion more confounded"; for *Carterius* is still a homonyme to *Carteria*. Changing the gender of a Latin name does not make it a new name.

Dosilia Dybowski, 1884.
(*Carterella*, Potts and Mills, 1881.)
Not *Carterella*, Zittel,, 1898.
(*Carterius* Potts, 1887.) (!)
Not *Carteria*, J. E. Gray, 1835.

1. *Dosilia Stepanowii* Dybowski, 1884.
Carterius Stepanowii (Petr.) Potts, 1888.

2. *Dosilia tubisperma* (Mills),——
Carterius tubisperma Mills, 1881. (!)
Spongilla——Mills, 1880.

3. *Dosilia latitenta* (Potts),——.
Carterius latitenta (Potts), 1881. (!)

4. *Dosilia tenosperma* (Potts),——.
Spongilla tenosperma Potts, 1880.
Spongilla tenosperma Potts, 1881.
Carterella tenosperma Potts, 1881.
Carterius tenosperma Potts, 1887. (!)

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Ecology of a Certain Orchid.

By Edward L. Greene.

The plant I have in mind is *Cypripedium acaule*, distinctly a noteworthy member of its family, rather unique even in so showy and beautiful a genus, on account of two large basal leaves from the midst arises its naked stem, almost too slender to support strongly its one large purple odorous flower; and the plant, is withal, something of a rarity. In the vast prairie regions lying to the southward of Lake Michigan there must be a number of botanists of the younger generation, I think, who never saw this *Cypripedium* growing. I myself who, within the last forty years have botanized on foot some thousands of miles on the prairies and in the woodland belts that skirt them in Indiana, Illinois, southern Iowa and southern Minnesota, never yet met with it in these districts.

I can not imagine that even a child, having in him the making of a botanist, would forget in after years the place where he first found this fine plant, the stemless species of Lady's Slipper.*

My own first coming upon this *Cypripedium acaule* happened when I was a botanizing child of seven or eight years. It grew on a wooded and rather dry slope above the Ashway, or, as they now call it, the Ashaway River, very near the village of Ashaway, Rhode Island. It was to me a startling discovery; for, used to ransacking all pastures and bogs, groves, woods and stream banks during several seasons before this, I had supposed I knew already all the native plants of my native township of Hopkinton; and here was

* I write it in that way advisedly; for it is certain that these plants were originally so called not in allusion to slippers of ladies in general. The meaning was Slippers of Our Lady, that is, the Blessed Mother. Away back in mediaeval times the universal Latin name of the Old World type of this genus was *Calceolus Mariae*.

† August 16, 1909.—Pages 61 to 80.

finest of them all, never chanced upon before in all my boyish botanizings. In my simplicity and ignorance I wondered if any one else had seen this curious glorious flower that hid itself away far from any path, in the most obscure shade of the woodland bank. I took it, root and all, to my home a mile away, purposing to make enquiry whether any one else had ever seen the plant and had a name for it. Several of my elders recognized it, and one of them said its name was Adam and Eve. I seem to have had the sense not to commit it to my mother's flower garden, but chose for it a shaded and precipitous bank close by; the sweet birch bushes and Kalmias, with the partridge berry (*Mitchella repens*) forming almost a turf at the place. As I remember with perfect distinctness, my transfer of the plant was to an exceedingly different spot, ecologically considered, from that in which I had found it; for there I had observed no kalmia, no betula, no mitchella, but only oak and hickory trees and hazel bushes, everything deciduous; the soil light and loose, of leaf mould; whereas in the proposed new habitat, the ground was clayey, also a little sandy. My transferred specimen did not reappear at all next season. Its new environment seems to have been fatal to it. Nevertheless, allowed to choose for itself, I know of no orchid, and of few other woodland plants, any one of which adapts itself to greater diversities of climate, soil and ecologic consociation.

My second meeting with this same orchid was at a station about one thousand miles westward from Rhode Island, where the climate is much more severe, where also both the nature of the soil in which it grew, and the plant association, were about as different as imaginable considering that the parallel of latitude is approximately the same. This, my second locality, was in the midst of a larch swamp in southern Wisconsin. Here *Cypripedium acaule* would have to be classed as a bog plant; for a larch swamp in Wisconsin is a very wet place; usually almost wholly sphagnous. In some parts of it the only way of getting about without wading, or else sinking deeply into the watery-spongy masses of sphagnum was to step from one to another of the large superficial and horizontally spreading roots of the larches. Under the coarse network of these roots seemed to be nothing but water.

The sphagnous border encircling the central forests of tamracks, or larches, yielded plentifully such interesting boreal shrubs as were then known by the names of *Cassandra calyculata*, *Andro-*

meda Polifolia, Kalmia glauca and Pyrus arbutifolia; then in patches of the more open sphagnum among these bushes grew such fascinating beauties as *Pogonia ophioglossoides, Calopogon pulchellus* and *Arethusa bulbosa*; while around and among them all were cranberry vines, and the little mats of several kinds of sundew. Not exactly among these sphagnophiles, but rather just under the shade of such larches as occupied ground a trifle more elevated, and where from the leaves of them and the viburnums and mountain ash bushes a slight depth of leaf mould had accumulated, one always found this fine cypripedium, also here and there along with it *Linnaea borealis*.

Now, as I have already said, the associations of this plant there in Wisconsin were in very marked contrast to those chosen by it in that part of New England where I had known it. And what may add still more to the interest of it in its tamarack marsh locality of the West, is this, that here, on wooded slopes like those where at the East one would have looked for this species, one met always with another cypripedium and not this. The southern boundary of the one Wisconsin marsh where I found *Cypripedium acaule* most plentiful was just such a rich shady hillside, sloping northward, of course; and this was the best station I knew of for *Cypripedium spectabile*; but no other grew there.

From the time of my observing *Cypripedium acaule* in the larch swamps of Wisconsin more than thirty consecutive years elapsed without my having once seen a living specimen of this fine orchid; years of sojourn and of travel in regions far beyond the range of it. I then came suddenly one spring day upon a large colony of it in a piece of low damp woods near the banks of the lower Potomac River in Maryland. I was fairly enthralled by the vision of so great a number of these beautiful things all in one place. I had been used to think it a piece of very good botanical fortune if ever I found three or four of them within a few feet of each other; and here there were some dozens of them to be seen at one view, and a considerable tract of this forest shade was in a manner covered with them; not, of course, that the plants were at all crowded together; they were scattered about, as usual, but the area occupied with them measured several rods, and there was such an almost total absence of larger undergrowth of shrubs and herbaceous plants as rendered many of the cypripediums visible at one glance.

During long years of ardent botanical field study I have been so well used to contemplate ecological conditions, that here,

almost from the first moment my delight in the absolute beauty of this scene, and the unexpected renewal of acquaintance with one of my childhood favorites, were mixed with a feeling of wonder at what to me seemed a new and strange kind of environment for this orchid. Naturally my ideal of a habitat for *Cypripedium acaule* was that of the frigid swamps of the far Northwest where hitherto my best acquaintace with the species had been made; a sphagnous swamp where mosses took the place of soil, and all the shade was that of a certain conifer. There, during nearly four months of every year the cypripedium roots were imbedded in ice; not in frozen earth, but practically in ice itself. Here in this low woodland of the mild South I doubt if ever in the middle of winter the ground freezes to the depth of an inch. The trees that make the shade are every one deciduous. They are nyssas, sweet gum, red maple, and hydrophilous oaks and ashes. No ericaceus undershrubs are near; there is no sphagnum, no moss or lichen, only a lycopodium or two; not a plant of arethusa or pogonia, though now and then one sees a little green-flowered achroanthes and an aplectnum, but no other orchids at all; and the leaf mould in which the plants flourish is more moist a great deal than that of the plants hillside habitat in New England. Indeed, not many rods away from where this fine colony grows the depression of the land falls to that of an open shallow pond that is occupied by no trees at all, but by boggy rhynchosporas and other sedges, and by sagittarias, sauruvus and peltandras, besides the lance-leaved subaquatic *Ranunculus obtusiusculus*. I have no other equally strong contrast ecologic in mind as that subsisting between the Wisconsin habitat for *Cypripedinm acaule* and this of the lower Potomac in Maryland. It is one of the ecologic marvels of my own rather wide experience in North American botany.

Once again, and within a few years, also in a locality of the Potomac water shed, I met with this particular lady's slipper, and this time high up on the northward slope of the Blue Ridge. The elevation was little less than a thousand feet. The ground was not in the least degree marshy. It was a yellow bank of sandy-clayey formation. 'The associated plants were mainly low azaleas, vacciniums antennarias and hawkweeds; yet another and very striking contrast.

I have been informed by that excellent Canadian botanist, Mr. James M. Macoun, that not far from Ottawa *Cypripedium acaule*,

while most common in low ground bordering swamps, has for an alternative situation upland rocky woods in the shade of sugar maples.

It is a part of the common experience of field botanists that most plants of any rarity, or special interest are always to be sought each in some preferred soil and other points of environment, and there associated with almost always about the same list of concomitant species belonging to other alliances. Striking exceptions to this general rule may perhaps not be found so rare as we have been accustomed to think, especially when marked species like this which have a wide distribution, shall have been studied ecologically throughout the whole of their exstensive range. But I doubt if any other North American plant will be found to occur under such extreme diversity of conditions as this one does, and that, as I suppose *Cypripedium acaule* does, without evincing any considerable diversity morphologically.

One botanical friend, much given to ecologic research, expressed a feeling of surprise at my account of this cypripedium, and wondered if the seeds, for example, of the high-northern bog plant would so much as germinate in the low sultry Potomac valley habitat.

The Name Stemonitis a Synonyme.

J. A. NIEUWLAND.

Taking as the fundamental rule for the nomenclatnre of plants that no names be accepted that antedate May, 2, of the year 1753, when the Species Plantarum of Linnaeus was edited, it must be shown that the name Stemonitis Gleditsch, 1753, was published later than the above date of Linnaeus' work, or the name as attributed to that author will not hold, assuming that date as the starting point for names of slime moulds. In some of the common texts* the genus is written Stemonitis, (Gleditsch) Rostafinski, 1873. The oldest name for the group of plants at present comprised under the genus is that of Micheli, † Clathroidastrum, given

* MacBride, T. North American Slime-Moulds (1899.)
Cooke, M. C. Myxomycetes of Great Brittain. (1877.)
† Adanson, M. Familles des Plantes, (1763) Vol. 11, p. 7.

in 1729. Adanson restored Micheli's name to the group in 1763, Linnaeus having either disregarded them or put them under another genus aggregate name. It is to be remembered that that Clathroidastrum as a name is objectionable from the Linnaean rules of nomenclature, but very little regard is had for the rules Linnaeus laid down, however reasonable they are. The name was formed from Clathroides, which in turn was patched up from Clathrus, the latter being the name of a genus of fungi. Linnaeus rightly suppressed all such names, but modern systematists not only accept them but have even created such. They are then hardly in a position to reject such a name as even Clathroidastrum for etymological reasons. As a matter of fact, the Linnaean rules of nomenclature are not only at present not followed, they are positively ignored. The name must be either Stemonitis, Gleditsch, 1753, or Clathroidastrum, Adanson, 1763, for those that go back no farther than Linnaeus for plant names, but Stemonitis, (Gled.) Rostafinski, 1873, is antedated. The name Stemonitis, as given by Ludwig Böhmer, in the Third edition of Ludwig's Definitiones Plantarum of 1760, is an impossible aggregate, containing the genera Stemonitis proper, Comatricha, Buxbaumia, one of the mosses, and Clathrus, Sphaerocephalus, Eubolus, several genera of fungi. Such a conglomeration of totally different plants under Stemonitis, cannot be accepted under that name by any reasonable scientific method of modern classification. If the month of the publication of Gleditsch's work is not given, as seems to be the case, then there still remains the doubt whether it was even as aggregate of both Stemonitis proper and Comatricha, published before May 9, of the year 1753, or whether after that date. Until this matter of doubt be cleared up we provisionally indicate that specific names of the genus now under Stemonitis, (Gleditsch) Rost. 1873, be referred to the older name, Clathroidastrum, Adanson, 1763. For those that do not take the year 1753 as the "starting point" for botanical nomenclature, the name Clathroidastrum, Micheli, 1729, seems to be the correct name, and as we shall try to show, is the oldest name for the genus under its modern limitations, i. e. separate from Comatricha.

As to the valid publication of the name by Adanson there can be as little doubt as for the publication of Mucilago, Adanson, now generally accepted without question. Though Adanson's descriptions are generally brief, and may be suspected of incompleteness,

his references in the cases in question to the more clear and lengthy description of Micheli taken together with the plate of the plant by the latter author, establishes beyond the doubt the identity of the Clathroidastrum of Adanson with that of Micheli. M. C. Cooke* apparently following the lead of Rostafinski, seems to infer that the genus Clathroidastrum of Micheli is an aggregate of Stemonitis proper and Comatricha, both names taken here in the sense commonly accepted.

Micheli quotes two species under Clathroidastrum:

(1) Clathroidastrum obscurum, Majus, Tab. 94, Fig. 1.

(2) Clathroidastrum obscurum, Minus, Tab. 94, Fig. 2.

The former is considered the type of the modern genus Stemonitis and has been called Stemonitis fusca, Roth, 1782, the latter has been generally considered to be the present Comatricha typhina, (Rost.) M. C. Cook or Comatricha Stemonitis (Scop.) Sheld. 1895, though on what grounds is not clear to me. May it not be possible that here as in so many cases in our modern nomenclature an error may have crept in which has been carefully copied by our mycologists no one ever challenging the names by careful examination of the original publication of Micheli?† That the first species of Micheli is a Stemonitis is generally admitted. May it not be possible that the second is also a Stemonitis taken in the modern sense? Examining the description‡ we find that Micheli states that the plates that illustrate his two species are shown in DD as drawn to their exact natural size,§ i. e. to use his own words: "Vera autem plantae magnitudo ea est quae figura DD repraesentur." Applying an ordinary instrument or rule to the figures we find that one measures 14 millimeters and the second, supposed to be a Comatricha, is exactly 10 mm. high. Looking up the description of *Comatricha Stemonitis*, (Scop.) Sheldon, or as some call it *Comatricha typhoides* supposed to have been plant No. 2 of Micheli, we find that it never exceeds less than one-half that size, or to be specific, it ranges from 2-4 mm. Moreover no Comatricha of such size was known at that time or for many years later. The natural inference is that the second plant described by Micheli is not a Comatricha but a Stemonitis proper, which one is

* Cooke, M. C. Myxomycetes of Great Brittain (1877) p. 46-47.

† Micheli, P. A. Nova Plantarum Genera, (1729) p. 214. Tab. 94.

‡ Do p. 215.

§ Do p. 215.

not for me to decide here. Following the description of Micheli which must be taken to mean what it says, the two species are certainly species of Stemonitis proper in the modern sense, and therefore Clathroidastrum is the oldest name for the group of plants hitherto put under Stemonitis proper and the latter name should be relegated to synonymy unless the name Stemonitis, Ludwig, 1760, be accepted. We give here the names in order of priority that would be affected by the acceptance of Clathroidastrum and unless the name be objected to on the grounds that it offends seriously against the Linnaean rules of nomenclature it has priority in its favor. We refrain from transferring the specific names for reasons laid down by Linneaeus in his Philosophia Botanica, regarding names in *oides* and *astrum*. Following is the list of American species affected.

Clathroidastrum, Micheli, 1729.
Clathroidastrum, Adanson, 1763.
Stemonitis, Gleditsch, 1753, in part.
Stemonitis, Ludwig, 1760, in part.
Stemonitis, (Gleditsch) Rostafinski, 1873.

(1) *Stemonitis fusca*, Roth.
(2) *Stemonitis confluens*, Cooke and Ellis, 1876.
(3) *Stewonitis nigrescens*, Rex. 1891.
(4) *Stemonitis maxima*, Schweinitz, 1834.
(5) *Stemonitis virginiensis*, Rex, 1891.
(6) *Stemonitis Morgani*, Peck, 1889.
    Stemonitis spendens, (Rostafinski), Lister, 1894.
(7) *Stemonitis fenstrata*, (Rex) MacBride, 1899.
(8) *Stemonitis Webberi*, Rex. 1891.
(9) *Stemonitis ferruginea*, Ehren. 1818.
    Trichia axifera, Bull, 1791.
(10) *Stemonitis Smithii*, MacBride, 1893.
    Stemonitis microspora, (Lister), Morgan, 1894.
(11) *Stemonitis carolinensis*, MacBride, 1893.
    Stemonitis tenerrima, (B. and C.) Morgan, 1894.
(12) *Stemonitis pallida*, Wingate, 1897.

Department of Botany
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Birds Found in St. Joseph Co. Ind., Each Day in May, 1909.

B. ALPHONSUS.

The daily observations recorded in this article were made in the vicinity of Notre Dame and St. Mary's, Ind., the St. Joseph River near the latter and the lakes at the former making these places ecologically among the best in the county for finding a large variety of birds.

My object in keeping daily records of all the birds I see is to ascertain which species are widely distributed in each month of the year. I also have in mind to note, as accurately as a single person can, the dates of the arrival and departure of each species.

The reader will be enabled to see by looking at my daily lists of birds found during May which species are very common, fairly common, rare or very rare. Those recorded but a few times are generally migrants which were passing to the north or late from the south.

The Screech Owl and Nighthawk are seldom seen here at this time of the year. The Bittern, Alder Flycatcher, Loon and Yellow-legs are birds that nest in low land near the water. The writer had no opportunity of visiting such a locality. The Cardinal, Rose-breasted Grosbeak and Scarlet Tanager usually prefer quiet places in uninhabited woods for nesting.

It is interesting to note that certain species were not seen at all during the month. Such are the Hairy Woodpecker, Downy Woodpecker, Yellow-bellied Sapsucker, Chickadee, Ruby-throated Hummingbird, Bobwhite, Whip-poor-will and Loggerhead Shrike. Most of these birds nest in deep woods, none of which were visited by the writer. The Shrike is a quiet bird that nests in hedges. The Hummingbird did not arrive until June. The writer has never seen a Sapsucker in the spring after April.

These four species were seen every day during the month: Song Sparrow, Purple Grackle, Chipping Sparrow, Robin.

The following were seen on every date except those that follow their names:

The following species were seen on the dates after their names:

Meadowlark 1, 11, 13, 26.
Field Sparrow 1, 2, 6, 8, 10, 12, 19, 26.
Cowbird 8, 10, 13.
Red-headed Woodpecker 1, 2, 3, 6, 11, 15, 27, 30.
Flicker 2, 8, 11, 12, 14, 15, 18, 19, 20, 21, 22, 23, 24, 30, 31.
Chimney Swift 1 to 6, 9.
Kingbird 1 to 7, 9, 10, 13, 14, 24, 26, 27.
Blue Jay 1, 3, 26.
Crow 1, 2, 4, 5, 6, 8, 11, 14, 15, 17, 19.
Orchard Oriole 1 to 6, 9, 10.
Baltimore Oriole 1 to 4, 24.
Bluebird 3, 6, 7, 8, 10, 12, 13, 14, 15, 20, 21, 24.
Hermit Thrush 6, 8, 30, 31.
Spotted Sandpiper 3, 5, 13, 17, 19, 21, 26.
Goldfinch 1 to 11, 16, 18.
Vesper Sparrow 1, 2, 3, 6, 7, 9, 10, 11, 12, 13, 14, 20.
Warbling Vireo 1 to 5, 7, 10, 11, 15.
Catbird 1 to 6, 8, 9, 11, 27.
Brown Thrasher 19, 22, 24, 26.
House Wren 1, 2, 3, 6, 10, 11, 13, 15, 18, 21, 26, 30.
Swamp Sparrow 5, 7, 19, 21, 25, 28, 31.
Loon 4.
Ovenbird 11.
Redstart 12, 13, 16 to 20, 28, 29, 31.
White-crowned Sparrow 2, 3, 4, 6, 11 to 14, 23, 24.
Yellow-legs 3.
Myrtle Warbler 1 to 7, 11, 12, 14, 16, 18, 19, 28.
Yellow Palm Warbler 1, 2, 3, 5, 9, 12, 14, 17, 18.
Black-throated Blue Warbler 9, 13, 19.
Black-poll Warbler 17.
Bay-breasted Warbler 19.
Kentucky Warbler 1.
Canadian Warbler 24.
Wilson Warbler 28.
Hooded Warbler 13, 24.
Tennesee Warbler 24, 26.
Wilson Thrush 3.
Least Flycatcher 22, 24.
Sprigtail 29.
Purple Finch 2, 4, 5.
Dickcissel 19, 23, 25, 31.
Yellow-throated Vireo 19, 23, 24, 28, 29, 30, 31.
Screech Owl 23, young bird.
Yellow-billed Cuckoo, 28, 29, 31.
Belted Kingfisher 2, 3, 4, 9, 23, 24, 25, 30.
Crested Flycatcher 27, 28.
Phoebe, 1, 6, 11, 12, 19 to 24, 26, 28, 29.
Wood Pewee 18, 19, 20, 22 to 31.
Bobolink 13, 17, 23, 27.
Red-winged Blackbird 3, 4, 7, 12, 16, 17, 18, 28, 31.
Golden-crowned Kinglet 3, 4.

The following species were seen on the dates after their names:

Ruby-crowned Kinglet 1, 5, 9, 10, 14.
Mourning Dove 2 to 5, 8, 12, 17, 19, 23, 24, 25, 27, 28, 30, 31.
Nighthawk 27.
Bittern 29.
Purple Martin 13.
Alder Flycatcher 25, 26.
Kildeer 11, 15, 17, 18, 20, 28, 29, 31.
Red-eyed Vireo 16, 19, 24, 26, to 30.
Snowbird 1, 2, 4, 5, 28.
Towhee 2, 3, 4, 16, 19, 23, 25, 31.
Cardinal 19, 27.
Rose-breasted Grosbeak 5, 9, 12.
Indigo Bird 5, 19, 21, 23, 24, 25, 27 to 30.
Barn Swallow 1, 2, 4, 6, 7, 17, 18, 19, 28.
Scarlet Tanager 19, 26, 28.
Cedarbird 27, 29.
Brown Creeper 3.
Yellow-Warbler 4, 5, 6, 9, 12, 13, 16 to 19, 22, 23, 27, 29.
Blackburnian Warbler 13, 17.
Maryland Yellow-throat 11, 19, 21, 25, 27, 28.
White-breasted Nuthatch 5, 8, 12, 14, 21, 23, 24, 26, 28, 29.

The following is the number of species seen each day of the month:

May	1,	18 species	May	17,	34 species
"	2,	21 "	"	18,	31 "
"	3,	26 "	"	19,	38 "
"	4,	27 "	"	20,	27 "
"	5,	29 "	"	21,	26 "
"	6,	18 "	"	22,	29 "
"	7,	23 "	"	23.	35 "
"	8,	20 "	"	24,	33 "
"	9,	26 "	"	25,	34 "
"	10,	17 "	"	26,	23 "
"	11,	25 "	"	27,	34 "
"	12,	29 "	"	28,	43 "
"	13,	25 "	"	29,	34 "
"	14,	22 "	"	30,	29 "
"	15,	21 "	"	31,	34 "
"	16,	29 "			

Total number of species seen during the month, 76.

Notes on Histological Technique.*

Mounting of Algae.

J. A. Nieuwland.

In a personal communication from the well-known phycologist Professor G. S. West, of the University of Birmingham, England, I received an outline of a method of fixing, mounting, and preserving algae which, as he tells me, has not been given the attention that it perhaps deserves. The fluid used serves at the same time as a killing, fixing, preserving, and mounting medium, and for delicate structures like desmids and other algal forms, it is said not to be surpassed. It has the advantage, moreover, that it keeps the natural coloring of the green algae, something which the instructor in elementary laboratory work will appreciate better than anyone else. The fluid is a 2 per cent. solution of potassium acetate, just made blue with a small amount of copper acetate. The substance reduces plasmolysis of the cell contents to a minimum. The algae can be put into the solution and kept in it. If a permanent mount is wanted a small amount of the material is put on a rather thick slide and sealed with old gold-size several times after each drying. The mounts are permanent, but it is necessary to take great care in sealing, and to this end to use a thick slide. A thin slide will bend considerably in handling, and the sealing may be separated in this way from the slide, so that the preparation will dry up as the result.

For some reason the fluid presents considerable difficulty with Vaucheria, and plasmolysis is hard to avoid. I have found that the best way to treat Vaucheria, especially the zoospores before or just after germination, when the plant is particularly delicate, is to kill it rapidly with 3 or 4 per cent. formalin. The formalin must be completely and quickly removed or the preparation will turn black afterward. Fixing for half an hour in the 3 per cent. formalin will not be injurious. Remove the formalin by repeated washing with water. If the Vaucheria thus treated is rapidly brought into glycerin to which a little thymol is added, the preparation will be

* Reprinted from The Botanical Gazette 47:237–238, March, 1909.

as perfectly green as when alive, and will retain its green color indefinitely. The method may be extended to all small green forms like the smaller liverworts, fern prothallia, and moss protonemata.

To get the material into glycerin, add first a considerable quantity of 5 or 10 per cent. glycerin in water, and put the dish near but not on a radiator. In a few days the evaporation will leave the fluid thick. Once the preparation is in thick glycerin the color will not change, if the formalin has been completely removed.

The potassium-copper-acetate solution will not keep the natural color of diatoms. It has the property of removing the diatomin or yellow coloring matter from the diatoms and leaving the plants perfectly green. The solution can thus be used in demonstrating the presence of chlorophyll in these plants. The diatomin is removed or absorbed in a few minutes after application.

As I have found some difficulty in keeping the microscopic mounts made in the potassium-copper-acetate solution because of drying, I have evolved a modification of the glycerin method in combination with it. The mounts made by this method are perfectly durable, and when carefully prepared are superior to ordinary glycerin mounts, as all the green algae treated with it keep their natural colors indefinitely. Glycerin jelly can also be used at the end to make the mount even more durable than the ordinary glycerin mount would be. The procedure is as follows.

The algae to be used are fixed in the potassium-copper-acetate 2 per cent. solution. After they have been killed and fixed in this fluid (the time varying according to the specimen treated), add to the above solution an equal part of 10 per cent. glycerin solution and allow to concentrate by evaporation in a warm dry place protected from dust. The algae must be thoroughly separated from dirt and soil or the concentrated solution will precipitate a reddish-brown cloud of reduced copper. In nearly all cases the preparation when thickened will be covered with a film of acetates, which can be removed from the top of the fluid without injury to the material. The concentrated solution should be perfectly clear, of a light green color, and the chromatophores of the algae perfectly green as in life. I have often been asked by students, and in fact by those well acquainted with algae, whether the plants thus given them for examination were not really alive. The advantage of having plant material, especially for elementary students, in a condition as near as possible to the live state, obviates explanations about stains. I

have found it very undesirable to give beginners any material other than alive or such as looks like the live stage of the plant studied.

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Teratological Notes.

II. An Abnormal Flower of Campanula rotundifolia.

A somewhat similar case of abnormal growth as was noted in the first number of the Midland Naturalist by Professor Kirsch in the case of *Taraxacum officinale*, Weber, was observed during the summer of 1906, in *Campanula rotundifolia*, *L.* This peculiar specimen of the Common Bluebell was found at Notre Dame, Ind., north of St. Joseph's Lake, on a dry sunny slope of a hill. The extraordinary shape and size of the terminal flower of the plant made it an object that caught immediate attention. The whole flowering axis of the plant was picked and s now preserved in four per cent. formalin.

The main stem and the peduncle of the plant from the root leaves to the abnormal flower at the tip, is flattened throughout and about one-fourth of an inch in width. Branching from this main axis appear at intervals a number of pedicels with normal flowers with five parts to their calyx and corolla. The apical abnormal flower is in general somewhat flattened. Its calyx is synsepalous and attached to the ovary the usual height as in ordinary flowers, but it has 32 teeth instead of the usual 5. The calyx-teeth are similar to those of an ordinary flower and all of equal size and perfectly formed, and 28 lobes of the corolla are present, these also of normal appearance. On account of the large number of the lobes of the sympetalous corolla, the flower has rather the appearance of a cow-bell, than an ordinary bell with the parts crimped and doubled in upon themselves in several places. The flower is perfectly full-blown and the anthers have in large part fallen away, adding to the difficulty of finding the exact number at present. The stamens must have been about 27–30. The style of the flower is flattened with the upper stigmatic part thickened, the

whole of about the height of the ordinary style. The plate-like style is about one-half an inch square and ridged upwards, all its edges being perfectly entire.

The ovary is of the same diameter as that of the normal flower, but is about three-quarters of an inch long, and contains about 30 cells in two rows horizontally on the torus. The ovules are to all appearances quite ordinary in general aspect.

During the spring of the same year another case of fasciation was found on the same hill in a specimen of *Claytonia virginica*, L. Three or four flowers seemed to have grown together into one, and only one such flower was found in the cluster.

III. Abnormal Specimens of Dandelion.

The following communication was received from Mr. E. W. Bowditch, of Boston, in reference to the article in the April number of the Midland Naturalist. With the permission of the writer the letter is here reproduced in full, as it may be of interest to our readers:

Editor Midland Naturalist,
Notre Dame, Indiana.

Dear Sir:

My attention has been called to pages 24, 25 and 26 of the April number of the Midland Naturalist where is shown an abnormal specimen of the common dandelion (Taraxacum officinale) with a statement, etc., of its occurrence over a limited area of a highly fertilized lawn.

If Prof Kirsch could travel from Utica to Binghamton, N. Y., by rail, at the season when the dandelion is in blossom, he would probably see a sight he never would forget.

At Hamilton, N. Y., where the writer has noticed the abnormal growth more in detail than elsewhere, it may be stated that acres upon acres of ground show the same peculiarity—not always to the same extent as shown in the illustration in the Midland Naturalist but there would be no trouble in collecting literally bushels of the plant showing abnormal growth on the grounds of Colgate University alone. No specimens were found having more than ten heads united.

From the fact that in places between Hamilton and Utica the railroad banks (fill) will be seen almost a solid blaze of yellow—when the blossoms are in their prime, and from the fact that most of the University grounds have never been treated to a thorough manuring, or kept as lawns, it may be questioned whether the growth is due to extraordinary fertilization, or to natural causes—Hamilton is comparatively high in altitude, the brooks are all strongly impregnated with lime and through the meadows where the dandelions show the best, the soil which is quite stony, is several feet deep.

Between Hamilton and Binghamton, the show of color from the car windows is extraordinary, and though I am not familiar with much of the country except from car windows, the fact that the railroad fills, which are preferably not made with rich soil,* literally blaze with color, would incline me to believe some other reason than rich soil might be responsible for the phenomenon. Yours very truly,

ERNEST W. BOWDITCH.

* Editor's Note. Since the publication of Prof. Kirsch's article we have found four or five cases of fasciation of dandelion. Usually not more than three or four heads were united, and the plants were in every instance found in very unfavorable conditions such as are indicated by Mr. Bowditch. One plant was found on gravelly soil on the edge of a cement sidewalk and the others coming up from an old cinder path. Another plant on the edge of a gravel walk had as many as eleven heads combined. It has been observed that very old clover plants are more apt to have more than the normal number of blades to the leaf. Such plants have been found to have more 4, 5 and 6-bladed leaves than 3-bladed ones. Might not age also have some influence on formation of abnormal growth?

Editorial Note.

"SPINELESS CACTI."

In the course of a conversation with a representative of one of the European governments we discussed the subject of the "spineless cactus." As scientific expert attached to a consulate the gentleman had been deputed by his government to investigate these spineless forms with the object of later securing such for the tropical colonies. Before, however, his report was sent in a purchase had been affected by the authorities at home. His report was not very favorable we were told, for the "spineless cacti" developed the unfortunate tendency of reverting to their primitive and ordinary spiny condition. In fact he came to the conclusion that at present the best way of easily and surely obtaining "spineless cacti" for fodder for cattle is to have a laborer go from plant to plant and burn off the spines with an ordinary oil-blast lamp.

In view of this it would seem that spineless forms of Opuntia are still far from immutable, and that very little reliance can be put on the glowing accounts of scientific discoveries as related in the

modern popular magazines. It may also be questioned whether in exact knowledge regarding "spineless cacti" we have advanced much farther that our ancestors of several hundred years ago.

It has happened many a time in the history of science that we discover or rather rediscover something that was known centuries ago, and in our happy ignorance of the past we give it out to the world as "brand new," while the world for a time blissfully accepts it as such. In things botanical particularly there may arise the belief that nothing worth while was known before the middle of the 18th century. Botanical congresses have over and over again legislated that no plant names used anterior to 1753 are valid. Not only ordinary botanists, that take their information second and third hand, but also those that pretend to rank in the first class, may be tempted to think accordingly that little or no scientific observation was made before the so-called "starting point" in nomenclature. Many there are too that still believe that Linnaeus was the sole author of the binomial nomenclature. Nor did Linnaeus even in the Species Plantarum use binary names solely as may be seen by looking into that work. Names of three words will be found even there in considerable number,—such as *Alisma Plantago-aquatica*. Binomial nomenclature is about as old as any nomenclature as it is the only reasonable one, and such names will be found by the hundred in such pre-Linnaean authors as Matthioli, John and Caspar Bauhin, Dodonaeus, and many others.

In regard to "spineless cacti" we find that they were known and recorded about as early as there is any mention of cacti whatever. If the spineless forms, the discovery of which we claim in glowing accounts, are not permanent, they are all nothing more or less than teratological conditions known and modestly recorded by the older herbalists several hundred years ago. The older botanists knew the plant by the name we still use, Opuntia, and also by several others such as Ficus Indica, the Indian Fig, Tune or Tunas and a number of other less commonly used names. We shall here append some quotations from such of the pre-Linnaean botanists easily available to us, though there may be others that may have referred to spineless forms of Opuntia. In order to establish beyond doubt that the plant referred to by the older herbalists is really the one we now hear so much of, we shall append at some length the description of John Parkinson, more for the sake of

identification than of proof. The other authors, mostly in Latin are equally lucid, but they will be referred to only briefly.

Parkinson* in his herbal refers to the plant in the following terms: "The Indian Figge tree, if you will call it a tree (because in our Country it is not so, although it groweth in the naturall hot Countries from a woody stemme or body into leaues) is a plant consisting only of leaues one springing out of another into many branches of leaues, all of them growing out of one leafe put into the ground halfe way, which taking roote all the rest rise out thereof, those below for the most part being larger than those above, yet all of them somewhat long, flat, and round pointed, of the thickness of a finger vsually, and smallest at the lower end, where they are joined or spring out of the other leaues having at their first breaking out a shew of small, red, or browne prickes, *a few very fine and small hard white and sharpe, almost insensible prickes*, being not so bigge as haires on the under side which will often sticke in their finger that handle them vnadvisedly, neither are they to be discerned vnless one look precisely for them: The leaues on the *vnderside having none of those other great prickes or marks at all*† being of a fresh pale greene colour: out of the uppermost leaues break forth certaine greene heads, very like unto leaues so that many are deceiued, thinking them to be leaues, vntill they marke them better and be better experienced in them: but that they growe round and not flat, and are broad at the toppe; for that out of the tops of euery of them shooteth out a pale yellow flower consisting of two rowes of leaues, each containing fiue leaues apeece, laid open with certaine yellow threads tipt with red in the middle: this greene head untill the flower be past, is not halfe that bignesse that it attaineth unto after, . . " etc.

p. 433. "This Indian Figge tree groweth dispersedly in many places of America, generally called the West Indies: The greatest kind in the more remote and hot countries, as Mexico, Florida, Virginia, and in the Bermudas or Summer Islands: from whence wee haue often had it, the lesser in Virginia and those other countries that are near unto us: which better endureth with us. . . Our people in Virginia, and the Bermuda Island, where it groweth plentifully, because of the form of the fruit, which is

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* John Parkinson. Paradisi in Sole, Paradisus Terrestris, 1629.

† Italics are the Editor's.

somewhat like a peare, and not being so familiar with the growing of Figs, sent it vnto vs by the name of the prickly Peare, from which name many have supposed it to be a Peare indeede but were therein deceiued."

We infer from this that the plants of Opuntia that Parkinson knew had but *few of the fine small prickles*, though he does not mention that he had seen them without these.

Dodonaeus in 1583* and 1618† states that spineless cacti were found though rarely.

Rembertus Dodonaeus Cruydt Boeck, 1618, Tot Antwerpen inde Plantynsche Druckerije (Dutch, 5th Ed.) p. 1274. "Voorts zoo zijn deze bladdren langworpich an breedt somtijts dicker dan eenen duym ende daertwt steeken veele witte dunne lange en scherpe doornkens *maer somtijts doch heel selden en hebben sij geen doornkens met allen.*" Translated. "Moreover these leaves are long and broad and sometimes thicker than one's thumb. From these spring many long thin white thorns. Sometimes, however, but very seldom they have no thorns at all."

As to the name of the plant Dodonaeus says here also that the plant was mostly called Tune or Tunas,‡ and he gives a binary name for it Tunas Americanum. Opuntia is also given as a synonyme, but the Opuntia of Pliny certainly was not our American plant. The name was mistakenly applied from Pliny by the early herbalists, because he said that the plant rooted from the leaves. Pliny applied the name to the other unknown plant because it was found around Opuns a city in Greece near the ancient city of Phocis. The oldest valid name for our plant is then that of Dodonaeus Tune or Tunas Americanum for we may yet find what the Opuntia of Pliny really is, and the Opuntia applied to our cactaceous, genus will then be a synonyme. The application of ancient plant names to newly discovered or segregated plants is objectionable as when last applied they are virtually synonymes. Linnaeus was one of the greatest offenders against this rule, and the practice is not yet obsolete.

Stirpium Historiae Pemptades sex, Antwerpiae, 1583, p. 802.

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* Rembertus Dodonaeus, Stirpium Historia Pemptades Sex. 1583.

† Rembertus Dodonaeus Cruydt Boeck volgens sijne Laetste Verbeeteringen. Dutch 5th Edition. 1618.

‡ Theophrasti Eresii de Historia Plantarum libri decem. Comment. Joannes Bodaeus A. Stapel. 1644.

R. Dodonaeus has the same in Latin: "Oblonga autem Ficus Indicae lataque; sunt folio pollice non raro crassiora, e quibus albidae, tenues oblongae, acutaeque prominent spinae (*raro absque his provenit.*) The translation is in substance the same as above.

Stapelius in 1644, in his commentary on the works of Dioscorides says that '*in Belgium sometimes the plant is found without any spines.*'

p. 40. Oblonga autem ficus Indicae lataq.; sunt folia, pollice nonnunquam crassiora, e quibus candicantes tenues, oblongae, acutaeque prominent spinae (*Quandoque tameu in Belgica absque his provenit.*) in extremis etc." He also mentions the name Tune or Tunas, as the one commonly used by the natives. "Ab Indis Tune vel tunas vocatur. In insulis Peruanis et potiissimum Hispaniola sponte crescit."

John Bauhin in his Historia Plantarum Universalis, 1650, referring to the works of Matthioli says that the latter had mentioned spineless plants. Matthioli's reference however, I have not been able to find. Neither the 1st edition of his commentary 1554, nor the edition of 1559 make any mention of the fact.

J. Bauhin and J. H. Cherler, Historia Plantarum Universalis, 1650. p. 154.

" Opuntia, Vulgo Herbariorum." *

"Ipsa vero quoque im magnam evadit arborem, cui folia magna longitudine interdum plusquam pedali, latitudine sesquipadali, ex oblongo rotundata, pollicem crassa, infima etiam crassiora durioraque supremis foris membrana tecta plurimis tuberculis asperata, e quibus spinulae albae acutae, facile contrectanti adhaerentes, infixoque aculeo stationem nativam deferentes. [*Matth., etiam sine spinulis visa testatur*] succo intus turgentia colore herbaceo . . etc."

It is evident then that spineless forms of Opuntia were known in the 16th century. It is also evident that strictly speaking the name Opuntia is applied to the cactaceous plant is a synonyme, Pliny's plant being an entirely different one. In fact in the work of Bartholomaeus Anglus, † printed in 1480, there is a commentary on the plant of Pliny though very little light is thrown by this writer on its identity, but that it is not a cactaceous plant is self evident, such not having been known before the discovery of America.

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* John Bauhin and J. H. Cherler, Historia Plantarum Universalis. 1650.

† Bartholomaeus Anglus, Deproprietatibus. 1480.

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Some Remains of a Past Fauna.

WALTER L. HAHN, PH. D.

During the summer of 1909, students in the Biological Station at Winona Lake, Indiana, discovered the remains of two species of the deer family. Both specimens were found on the grounds of the Winona Assembly and both are deposited in the museum of Indiana University.

One of them is a portion of a lower jaw of the Virginia deer (*Odocoileus virginianus*). It was found on the gravelly bottom of the south bathing beach and was not covered by silt or debris. The mandible was broken squarely just behind the symphysis and also behind the molars as though by a blow from a dull instrument while still attached to the cranium by flesh and ligaments. Deer were abundant in this region until the early fifties and were not exterminated until twenty years later; so that the occurrence of this bone in a good state of preservation is not surprising.

The other specimen is of more interest. It is a portion of an antler of the wapiti or elk (*Cervus canadensis*). Although elk must have been fairly numerous in Indiana when the region was first settled, they had become nearly extinct by the time the state was admitted to the Union. Their remains are by no means common and there are but few records of the actual occurrence of the species in the state.

The antler mentioned above, was found in the bed of Cherry Creek about one-eighth of a mile from its mouth At this point the creek has cut a narrow channel, about six feet deep, through marl and loam. The antler was probably exposed by the erosive action of the stream and perhaps uncovered by the breaking down of the bank. Its age is therefore problematical but it apparently belongs to a recent rather than a prehistoric species.

* October 15, 1909.—Pages 81 to 104.

The "Knee-Joints" of Species of Mougeotia.

During the spring of 1907 I was fortunate in obtaining some good conjugating material of *Mougeotia scalaris* (*Mesocarpus scalaris*) specimens of which were sent to a professor in one of the western universities. The plants were said to be the most typical he had met with, and he called my attention to the fact that he seldom if ever had found this plant in any other condition except that of the formation of the "knee-joints." From the context of his remarks I was led to believe that he considered this formation of the often observed "knee-joints" of this plant as a stage preparatory to, if not an actual stage of the process of conjugation. As I had not devoted much time to the subject before my attention was called to this phenomenon, and being well acquainted with all the stages of conjugation of *Mougeotia scalaris* (*Mesocarpus scalaris*) and *Mougeotia mirabilis* (*Pleurocarpus mirabilis*) I became very much interested in the problem and sought the very next occasion to try to gain some information of the phenomenon of the formation of the "knee-joints." I had often seen these angular contact formations in vegetative filaments of these plants, and my very first suspicion as to the nature of them and their meaning was that whatever biological interpretation might be put upon them they certainly were not a preliminary stage in the process of conjugation. In fact after studying carefully all the stages in this formation of the zygospore of either species of *Mougeotia* mentioned, of which I had an abundance of splendid material in every stage of conjugation, I was sure that the "knee joints" were not conjugating stages. After consulting Dr. G. S. West I was informed that the "knee-joints" as a problem was not thoroughly understood and presented an interesting phenomenon to be investigated.

That the process mentioned is not a stage of conjugation, which I think many believe, is evident from the fact that the sexual process of the formation of zygospore is quite different. Of course in *Mougeotia mirabilis* this is self evident because conjugation almost without exception takes place between adjacent cells in the same filament, the zygospore, being formed in the protuberance between the two cells. "Knee joints" are always formed by the distinct filaments of cells approaching one another, and forming an angular contact between a cell of one filament with one of another filament. The bend is usually only in the cells that come in con-

tact when cells at the ends of the respective filaments show the phenomenon, the union is effected usually in different geometric planes as well. No protuberance is formed as is the case in the process of conjugation, and as far as I have been able to ascertain the contents of the cells in contact of the different filaments never fuse, or form any opening whereby the contents could pass through from one cell to another. The contact of the cells seems all that results, and the walls of the cells at the angular point of union are not perforated, but simply become fastened or glued together over an area which does not exceed the diameter of the cells.

In conjugation of *Mougeotia scalaris* between different filaments, protuberances are formed that gradually approximate, and finally on contact open, and the two gametes combine with the formation of the zygospore half way between the filaments. There is no stage in the process of conjugation of this plant that in any way resembles in the least the formation of "knee joints." Zygospore and "knee-joints" I have never seen in the same material so that it may be concluded in a way that they do not occur at the same time, and are therefore entirely distinct life phases that have an entirely distinct bearing on the life functions of the plant. As I have never seen typically conjugating material with "knee joints" so I have never seen the "knee joints" in any except in typically vegetative stages, and not even when there was a single zygospore present. I have made a great many examinations of vegetative and conjugating *Mougeotia* and the conclusions seem fairly conclusive to me.

The question has often come up to me in the past few years: "What is the biological meaning of the "knee joints?" I have often sought for a favorable occasion to study the problem, and at last a chance presented itself when I found an abundance of *Mougeotia* in one of the jars in the laboratory. The material was as healthy, and typical as I have ever seen in the field, and was exclusively in the vegetation condition. At first very few plants were present, and in a few days microscopical examination revealed the presence of the "knee joints." A considerable time was spent in studying the nature of the union. It was noticed that in a number of cases of the phenomenon, and apparent degeneration, or darkening in color, of the platelike chromatophore of one or both of the cells was noticed at which the filaments combined. I had about decided after a number of continued investigations to give up the problem, when by accident a

very slight contact of the coverglass with my finger, revealed the fact that the filaments where "knee joints" were present became completely disintegrated to such an extent that all or nearly all of the cells in such filaments separated from one another and became free floating ones that presumably would be able each to develop by repeated division into new filaments. Normally the cells in a filament of *Mougeotia* hold firmly together so that it more readily breaks across the middle of a cell that at the place when two cells are attached. The process of jaming or disturbing such material was subsequently advertently tried and the same disintegation of filaments resulted, in material with "knee joints" present. Moreover it was observed that some days after the appearance of the bendings the amount of *Mougeotia* increased enormously, and especially the number of filaments was greatly multiplied, thus lending favor to the supposition that the disintegration of the cells following the phenomenon of "knee joints" was a device for increasing the number of plants, each free floating cell of subsequent division becoming a new individual. Looked at in this way the bendings might be interpreted as a phenomenon preliminary to the process of vegetative multiplication of the individuals, and may be considered as the first step in a process of multiplication of the plants.

Though no protoplasmic contents can apparently pass from one filament to the other at the point where the union of the bends, still it is not impossible that certain more or less soluble substances be exchange at this point by osmotic pressure between the two filaments. Such substances might affect by mutual exchange the condition of the protoplasm of either individual plant one of the results being the tendency of the cells to disintegrate. These conclusions or theories may be unwarranted by the premises, but certain it is that the "knee joints" are not stages of conjugation as I have found to be a prevalent belief, and likely it is that they serve some important function in the plant whatever this be, and though they may have been frequently observed either their purpose has been misinterpreted or overlooked. Though the explanation here offered is probably both unsatisfactory and, owing to more detailed and continued investigation unwarranted, we offer it only as a suggestion or an explanation, and feel that we may insist that "knee joints" have no bearing on the conjugation process whatever, as none of the stages of the latter in any way resemble the phenomenon in question.

Hints on Collecting and Growing Algae for Class Work.

J. A. NIEUWLAND.

A great deal of worry and trouble is usually anticipated by the teacher in obtaining cryptogamic material for classes of botany. During the past few years I have received so many requests from high school instructors regarding methods of procuring such plants, that I thought it advisable to outline briefly some general and particular methods that may be of help to the teacher. Necessarily many of the hints here given will be well known to the algologist, but the average instructor in botanical technique may not have had the time and opportunity to acquire experience which to the expert is likely to seem commonplace. Many, apparently even experienced instructors, well acquainted with the higher plants, I have found confess that they are unable to obtain the most common and ordinary forms of the lower plants.

As a matter of fact it is not especially difficult to obtain or even grow the lower plants, and most of them once gotten are easier to keep a long time than the phanerogams. There is required, of course, a certain knowledge of the habits and methods under which the development of algae proceeds best, but with a little experience, acquired only by patient reiterated efforts at growing such, their response to attempts at cultivation will soon be surprisingly gratifying.

Our common text-books and even systematic treatises do not give us much help in growing such plants, and for the most part do not even state clearly the habitat of the same. Nothing is said about the cultivation of lower plants in the laboratory. The object of this article, then, is to supply in a limited way, some hints for obtaining and growing the common types of algae, from the field or laboratory aquarium.

Here, more than in any other undertaking experience, often fraught with failure is the best instructor and guide, but as it is also true that most teachers have not even the right idea how to make a start, I shall feel repaid if I can hope that some, at least, will realize as the result of these few hints that it is worth while to make the attempt even though many failures result. A few suc-

cesses will repay for many failures. At the very outset we shall find that growing algae in the laboratory will be, on the whole, an easy matter in spite of the fact that at present we know very little about the subtle influences to which these plants respond. We may often feel obliged to refer our successes to luck, but as the chances of success and failure are about equal on the average, the results of the game are worth the venture, and after a number of failures we come to feel that a series of successes are due to us as a result of effort, while he that never tries dares not even hope to succeed even once.

Nearly all the plants ordinarily demanded by the common text as types for instruction can, with reasonable foresight be obtained in the laboratory aquarium by development, or be found out of doors in nearby ditches and pools. Often preserved material answers our demands almost as well as live material, so that if any particularly good specimens are found in the field, they should be gathered and "pickled" in as large a quantity as obtainable. Though plants will often appear annually or periodically in places where once found, it is well to consider that the next periodical appearance in abundance in any given locality may be as long as ten years away, and that it is therefore best to obtain as much as possible even at the cost of considerable inconvenience.

We know little or nothing about the periodicity of the reappearance of algae in any given place, and hence there is no other circumstance when it is so-much worth while to make the best of an opportunity, as in case of an abundant appearance of some rare specimen of algae.

I shall first discuss some general considerations helpful to success in growing algae in the laboratory, and then give detailed methods for some common individual specimens.

The first and most common mistake made by those that attempt to keep algae alive in the laboratory is to change the water in which these plants are. The motive for so doing is a well intended one, but there is a fallacy connected with it. The reason usually given is that a change of water prevents decay by the action of bacteria. Paradoxical as it may seem there are few if any of the hardiest algae that can stand such hard treatment though well meant.

A little reflection will show that since it is so difficult for the lower plants to accomodate themselves to their environment, a

daily change of water means a daily change of environment, and they have no sooner made an attempt to react favorably to their surroundings and begun to accomodate themselves when new conditions are again forced upon them. Therefore changing more than once the medium in which they are, is doing them the greatest harm possible, and under the circumstances algae almost invariably die, and disappear very soon, sometimes not to return. It is, therefore, just because these plants are so delicate and are affected by influences so subtle that we do not yet fully understand them, that we must refrain from multiplying the difficulties under which they thrive. The fact that most of these plants are normally found in stagnant or still water, which nature does not change, at least during their lifetime or growing period, is proof enough that they grow best in water in the laboratory which most resembles their natural habitat. Some algae like *Chætophora*, *Batrachospermum* and *Ulothrix* are found in running or dripping water in their native abode. Such plants are, however, permanently transplanted from the field to the laboratory with the greatest difficulty. It is almost impossible to preserve live *Ulothrix*, for any length of time, whether put into still or running water after collecting.

In general, plants must be brought from the field to the laboratory with conditions as near as possible to those under which they are found, and so kept. It is always best, when possible, to put into the vessels the very water in which they were obtained. Some algae can not stand the shock of being transferred to other water in the aquaria. A single change of water is fatal to them. Such delicate forms may, however, be obtained and made to grow by a method which will be outlined in the course of this article.

Algae which can withstand the shock of a single change of water from the field to the tap water in the aquaria will present no great difficulties in their successful growth. Often it will be found that they disappear for the time being. The beginner will conclude that they have completely disappeared as the result of bacterial action, or death, when they have only gone into some resting stage in the form of reproductive spores, usually as hypnospores. The temptation then comes to throw out the contents of the jar and begin over again with another culture. Starting another culture is of course a good thing to do, but it is also good to leave the contents of the jar for a few months, and it will be invariably found

that the disappeared forms will rather suddenly come back, often in better condition than when first found in the field, or if the plants do not appear, others equally or more valuable will develop, for which we have sought with as much care. Algae are never found in their native habitat in pure culture. The disappearance of one specimen is often but the reason of the appearance of another that only waited for its predecessor to go in order to come upon the scene itself. When the same algal forms reappear it is but a sign the resting stages of the reproductive organs had been slowly adapting themselves to an environment in which they finally found it possible to germinate and thrive.

The contents of an aquarium need only be thrown out when complete organic decomposition has taken place which is indicated by the presence of bacteria, often by a purple-violet coloration of the water and always by an over-powering disagreeable odor of decay. Even after this, however, desirable plants in form of Myxophyceae especially *Oscillatoria* have subsequently been known to develop. Another instance in which it is advisable to pour out the contents of the jar is when a small form of *Oscillatoria* appears. This is easily recognized under the high power of the microscope, but even as a type of *Oscillatoria* it is not valuable, as it is too small to serve for demonstration. The cells and contents are better brought out by larger forms. Moreover the plant prevents the development of all other desirable plants except other Myxophyceae such as *Glaeocapsa*, *Chroococcus*, *Anabaena*, *Nostoc*, *Tolypothrix*, *Cylindrospermum* and *Rivularia*. Whenever this small *Oscillatoria* obtains possession of a jar it destroys everything else either by crowding it out or choking it to death or actually posioning it, by means of some evil smelling compound partly soluble in the water in which the plant is found. Even *Cladophora* which is one of the most hardy of the algae and which will stand continuous changes of water quite well, and will remain several years unchanged in a small bottle without being affected noticeably, will disappear quickly under the influence of this small dark blue *Oscillatoria*.

Complete removal of this enemy of the aquarium is only effected after very thorough disinfection of vessels with formaldehyde, or another equally energetic disinfectant. The *Oscillatoria* does not seem to prevent the growth or reappearance of other Myxophyceae (Cyanophyceae or Blue Green Algae) and a good culture of any of these need not be disposed of to prevent the ravages of the enemy.

It is, however, best to keep the *Oscillatoria* out of the laboratory as completely as possible, because if tolerated in but one jar it will almost unaccountably spread to all the others until it has become so prevalant that no plant can be raised or kept in the laboratory until the whole room has been thoroughly and completely disinfected. I have found this plant a greater enemy to the laboratory and aquarium than any and all bacteria together. The latter, as a rule, have definite periods of growth and for a long time their ravages are interrupted, but the *Oscillatoria* is always present and never ceases its ravages. Hot water is not sufficient to kill the plant. Some of the congeners of this plant are known not only to exist but actually to thrive in the almost boiling water of some of the springs and geyser basins of Yellowstone Park.

Bacterial decomposition can best be prevented by avoiding the introduction into the jar of too much of the collected specimen. But a small amount of any given specimen should be put into a jar, about a cubic inch of plant mass to the gallon. Nature will often subsequently grow plants in larger proportion both in laboratory and the field than this, but nature has also already gradually accommodated the plants to the environment, and this accommodation has not been effected when we start a new culture.

It is advisable to have small aquaria. The jars should not ordinarily be larger than six gallons capacity and the best results have been found to take place in one or two gallon vessels. Aquaria of twenty gallon capacity are good for raising crustacea entomostraca, worms, insects and even higher animals but these are among the greatest enemies to the algae. *Cladophora* also develops beyond all bounds in large vessels once it has gained access, and usually spreads so rapidly as to choke out more desirable plants.

Large insects in an aquarium should be removed. No good ever comes of their presence, and many destroy plant life. Water snails are very destructive and reproduce very rapidly. Good crops of desirable plants will result after *Branchypus*, or water shrimps have disappeared, but their presence in a jar of plants is not desirable, and with the organic matter which they consume they certainly consume a considerable amount of unicellular algae and reproductive stages of higher algae. Entomostraca and small crustacea are great enemies to growth of plants and it is very difficult to get rid of them because of their small size.

A good check can be put upon them, however, by introducing

temporarily into a jar some *Utricularia*. This plant has its leaves provided with little bladders in which entomostraca and small water insects are caught in large numbers and removed from the scene of their ravages. These little bladders are very numerous and I have found at times as many as half a dozen small insects captured in a single one.

The jars in which filamentary algae such as *Spirogyra*, *Mougeotia*, *Zygnema*, *Œdogonium* and others are grown give better results when the bottom of the vessel is covered with about an inch of clear washed sea-sand. In some manner not quite evident, I have found that jars with sand in them are not so likely to decay by bacteria. To clean the sand it is sufficient to allow a stream of hot water to drip on it in the jar for half an hour. If the sand had ever been present where *Oscillatoria* or other Myxophyceae had been it should be disinfected by soaking over night in formaldehyde and subsequent washing with cold and hot water in turn.

The water which is used in the aquaria should be ordinary pump or tap water,—the former being preferable. If tap wâter is used it should be allowed to run quite a while, at least five or ten minutes before the jar is filled. The water standing in pipes takes up, especially in presence of carbon dioxide, small and often inappreciable quantities of iron, lead, or other metals, in solution, probably not from the metal, but from the ever present oxides and rust. These minute quantities of metallic salts are very destructive especially to the conjugatae and unicellular plant forms. Hard water, or water with lime in solution is also not the best for the abovementioned plants. The hardness of the water can be almost totally removed after a time by the introduction into the jar of one or several young green plants of *Chara*. This plant has a large percentage of lime in its cell wall and cell contents, and grows best in water when lime is present: and it serves well to eliminate it from the aquaria. This is probably the reason why Chlorophyceae in the presence of *Chara* react more promptly in accommodating themselves to their environment when put in the fresh water of the laboratory jars.

Some of the plants introduced into the laboratory jars from the field will take kindly to their environment if the water is not thereafter changed and the precautions and methods of treatment as outlined are followed. Others will disappear for the time and later come back in greater or less abundance most of them passing easily

into their reproduction stages. A quicker way than this latter more or less uncertain one has been devolved and considerable success attained. It has been found that if mud, grass, sticks of wood and the like are taken from the place in the field where certain plants have been observed or are known to have been present, and this mud is put into the laboratory jars, there will often in the course of a few weeks result a luxuriant growth of the plant even though no traces of the plant can be found at the time of the collecting. This method is especially applicable in winter, and then most striking in its results. The method applied at that season is not unlike that used in "forcing" the higher plants for flowering at Easter. An example which was several times repeated will illustrate this. In the winter of 1907 some mud, wood, and weeds that were found in an old barrel in the ground from which a spring gushed part of the year, were brought into the laboratory and put into a gallon beaker. Nanandrous *Œdogonium* had been collected there in the preceding spring and the material was excellent. The time of collection was about the middle of December in the course of a few warm days when the snow disappeared and the ice had thawed out by the warmth of the sunshine. A day or two after the material was introduced into the laboratory a blizzard came up rather suddenly. Snow fell that did not leave the ground till spring. In the laboratory the jar became covered within a week with a green coating, and it was found to consist of numerous zoospores which soon attached themselves to the walls of the vessel, changing their cilia into "holdfasts." They grew rapidly and in great abundance so that within a month and a half, I had a large amount of the best nanandrous *Œdogonium* I have ever collected. The culture was practically pure, and had the advantage that it could easily be removed from the glass walls of the beaker without injuring the plants in the least. From time to time the plants were removed, and were found in all stages of sexual reproduction. As fast as the older plants were removed every few days new growth replaced them, this continuing until May of 1908. It seems then that bringing the mud containing the oospores into warm laboratory from the winter conditions outside had the same effect as the return of spring upon the plants. This "forcing" process was tried several times since, and though not with such striking results, a good growth of reproductive nanandrous *Œdogonium* was obtained. If the mud is introduced in two large a quantity propor-

tionately to the size of the jar bacterial decomposition will result. The process was also tried with other plants and usually with good results.

Striking results are always obtained with *Vaucheria geminata*. The plant begins to appear late in the fall in its native habitat around springs and in pools. At the beginning of winter it has usually attained a considerable length of the filaments. The winter usually comes on it in the vegetative stage, and in shallow pools it is frozen hard in the ice until Spring. Cakes of ice containing this plant may be put into cold water and within a few hours after melting out be brought into a warm room. Several days later, so great an abundance of zoospores will result that they literally cover the surface of the aquarium, and can be scooped off in all stages of development for study. If the spores are left they will develop into new plants, which in the course of a few weeks will begin to develop an abundance of oogonia and antheridia, while the older plants will disappear. The plant can then in this way be made to produce zoospores any time during the winter season. A rather large aquarium serves best, and flowing or running water is not necessary, nor any regulation of light as is usually prescribed for zoospore production by older methods at other times of the year. *Vaucheria sessilis* will respond as favorably as *Vaucheria geminata* to such treatment but the latter is usually more abundant. *Vaucheria sericea*, a much smaller species than the two preceding has also been used with success.

Diatoms which are usually present in large quantities around springs and in pools and ponds can be taken into the warm laboratory in like manner and within a few hours afterwards will show at their best their characteristic movements. These plants always show their movements best shortly after being brought from colder to warmer water, so that in summer even, their motion are best demonstrated when brought from cold spring water to the warmer surroundings of the laboratory.

By a process of treatment not unlike the ''forcing'' method just cited, *Hydrodictyon* was last winter made to develop in the laboratory when there was freezing weather outside with several feet of snow on the ground. A jar in which a small amount of this plant was put for preservation during the fall and winter, was put on a window shelf just over a radiator where the heat was excessive and constantly equal day and night. The great heat brought about a

condition of environment not unlike that when this plant is reproducing in July, and with the same results. Nets were produced in all stages and sizes during the rest of the winter and only disappeared late in Spring. In another window and in another room similar results were obtained with the accompanyment of zoospore formation. These zoospores were found in vast numbers escaping through a small opening in the mother cell wall. Specimens of the net in various stages of formation were sent to a student in another university, who induced zoospore formation in the cells by sudden lowering of the temperature and subsequently raising it. Such results seem to me worthy of note as I had never before had occasion to have *growing Hydrodictyon* during the winter months.

To illustrate the regularity with which some algae will reappear in the jars even after all trace of them has been lost, Rivularia may be quoted as an example. Four years ago a good crop of this plant appeared in great abundance in one of the jars early in Spring. It has reappeared every year since then about the same time. *Tolypothrix* has also come out annually in one of the jars the contents of which were not disturbed during several years.

Monoecious forms of *Œdogonium* appear annually and usually early in spring. The first appearance of this plant is usually accompanied with the formation of asexual zoospores which seem to multiply the individual filaments. This stage is usually recognized by the kinky twisted appearance of the plant. The zoospores either escape from small holes formed about the middle of the filaments, or by breaking up the cells usually near one end of each cell in the chain thus causing a zigzag appearance of the filament seen under the microscope, and a kinky interwoven appearance as they can be seen by the naked eye near the surface of the water. Later on as the filaments increase in number, oogonia and antheridia are formed.

Coleochaete scutata is ordinarily considered as a comparatively rare plant. Its periodical appearance in undisturbed aquaria is worthy of note. The plant remains attached to the walls of the aquaria for many months at a time, constantly increasing in diameter, often while the interior cells near the centre have completely rotted away, so that the plant looks like a ring rather than a plate. Such old plants in the laboratory nearly always eventually illustrate a peculiar method of vegetative multiplication. At the edge or near the last ring of cells, there are developed at intervals new centres of

growth, some cell or group of cells acquiring the power of multiplying in all directions and becoming ultimately new plants. Six to ten new plants are often produced from a large old one.

This power of multiplication in radial direction not infrequently is acquired by cells five or six layers inward from the circumference though usually the cells on the perimeter alone become centers for the formation of new plants.

We have found that *Coleochaete scutata*, at least in the vegetative stage is not at all a rare plant, for there is hardly a single month in the year that one or other of the jars does not contain this plant in one or the other stages of development. Dr. G. S. West of the University of Birmingham has written me that though in vegetative stage it is common in England he has never seen it in fruit growing in the laboratory. Plants with antheridia and antherozoids we have had frequently, and nearly every culture shows these when the plants are young. Plants with divided carpospores I have found in the laboratory several years ago two or three times, and fixed material is still on hand.

Desmids in conjugation have never been obtained by us in laboratory cultures, but such cultures were reported to me from the University of California. Vegetative *Closterium* is easily transferred to the laboratory, and there kept for a long time, continually dividing. Conjugating forms of small Spirogyra will appear usually in spring, as also such stages of *Zygnema leiosperma*. Larger jars of ten or more gallons capacity seem favorable to their growth. One to two gallon jars will often produce zygosporic material in spring when well exposed to sunshine. I have found that it is at times only necessary to transfer *Diaparnaldia* in early spring from its native habitat in ditches to the laboratory in shallow vessels, in which some organic matter such as bits of meat or flies are put when an abundance of zoospores will be produced. *Chaetophora* too will produce zoospores in the laboratory. Early in summer is also the best time to obtain sexual stages of *Achlya*, or fly-mould. This thrown into stagnant water from ponds first produce oogonia and antheridia and later zoospores exclusively.

Though the water in aquaria where algae grow should never be completely changed at any time it is necessary to replace the water that disappears by evaporation. The plants will of course after a certain time remove all the salts that are present and serve as plant food. These salts can be supplied in two ways. Water is

added from time to time to supply what has evaporated but the amount added at any one time should never exceed one fifth of the total contents of the jar, or the plants may be either killed or seriously retarded in their growth. The water added contains enough salts in solution to last the growing plants for some time. Another method of replacing food removed from the jars in the process of growth is to add the salts directly in the proper proportions as shown by Sachs. Such plant food can be obtained in the form of tablets* and one can be added to a jar every few months. For algae one tablet to every quart of water contents of jar added occasionally gives good results, and is a safer method than adding fresh water, the shock of which often proves fatal. In supplying water removed by evaporation, care must be taken that the water when taken from taps be free from rust, and that accordingly the the water be only taken after it has run for some time. Iron is fatal to Conjugatae. It has been found that it is dangerous or destructive to such a hardy plant as *Marsilia vestita*, one of the Pteridophyta.

A method of obtaining or rather preserving algae alive depends on a principle just opposite to that of "forcing." A considerable number of typical algal forms appear in summer or autumn when they cannot be used for demonstration. Among these are *Hydrodictyon* and *Spirogyra nitida*. By putting these late fruiting plants in a jar in a normal diffusive light in a cool place they will last for months with little change. Spirogyra nitida I have thus kept in fruiting condition till spring, and this plant usually starts zygospore formation at the end of September. Hydrodictyon plants have also been kept in a cool well lighted place without decay until Spring. The reproductive stages at maturity remain a long time unchanged, and are not so subject to decay as vegetative stages. It might not be an entirely unprovitable procedure to attempt the arrest of the growth of plants in desirable stages until needed for demonstration. It might be of interest to find to what extent living plants will submit to preservation in mild state of cold storage until needed for class work.

In regard to collecting algae from the field for class use best results are usually obtained in Spring. Most of the useful plants for class study appear then in our latitude but many remain or re-

* These tablets can be obtained at very reasonable terms from Mr. E. F. Bigelow, Arcadia, Sound Beach, Ct.

appear in various places throughout the summer. Others never come till summer. Small pools and especially such as are dried up part of the year have been found to be most fruitful of the best forms as well as the greatest variety of forms. In large ponds and in streams of some size, or even backwaters of rivers water animals, crustacea, minnows destroy algae. Places even small that are permanently wet may have an abundance of material such as, *Spirogyra*, *Mougeotia*, *Œdogonium*, desmids free floating or as plankton, but oftener plants illustrating reproductive stages will be obtained from small bodies of water, streams or pools where the water has disappeared in summer or fall. Unicellular plants of Protococcoideae are usually found together. *Euglena*, *Pandorina Eudorina*, *Gonium* colonies are commonly found in summer as constituents of the green scum on the wallows in fields where pigs are kept. Wet places near troughs where cattle are watered are often covered with *Euglena viridis*. Water pools near barnyards when manure is present also contains *Euglena* and other Protococcoid forms, especially when exposed to the hot sun. The *Pandorina* is usually found showing all stages of formatión of smaller colonies within the old cells.

Pediastrum is usually found growing with Hydrodictyon and can be best obtained from the deposit falling from the floating plants to the bottom of the vessel in which they are kept. Often Pediastrum simplex is found with other unicellular forms or in common plankton floating on ponds. Desmids that secrete mucous are always found in shallow pools or sluggish streams either at the bottom when the water is cold, or rising to the surface when the water is warm and of lower specific gravity. Whenever such plankton is found in abundance which is rarely, conjugating forms will be present. The appearance of the plankton is that of a slimy mass often mucilaginous, but seldom or hardly ever stringy. *Haematococcus* grows only in rain water, and can usually be found in basins or other places where such water collects. It is ordinarily found only after rain.

In collecting as well as growing algae great patience and persistence is necessary. It is always difficult to find the good stages of algae especially the rarer ones even when one has the best equipment for collecting such. The microscope we have found most suitable is an instrument already described in these pages.* One

* MIDLAND NATURALIST, Vol. I, No. 2, p. 53.

must make it a rule to examine every bit of material one meets on a collecting expedition, and it often happens that the best plants are found where they are the least expected. It is a mistake to think that the greenest and best looking scums contain the best plants. Reproductive stages of plants are usually found in yellowish or muddy uninviting masses, whereas the green masses are common vegetative states of algae.

The most important principle of all to follow is, however, that better results and more success will invariably be had rather by doing intensive and thorough work over a very small area, than a superficial and occasional examination of a large tract of country. From the data given above one may get a fairly good idea of what constitutes a likely place where algae are to be found. Once such a locality is fixed it is necessary often to make trips to it, every few days to watch the stages of the various plants present. About three fourths of the useful and rare algae I have found in the last five years were obtained from ditches along a railroad within a quarter of a mile of its length. The collector will soon find in his neighborhood the best place where these plauts are found. By visiting such a place frequently for only a single season, one will eventually be surprised at the success attained. One will soon be able to tell almost at a glance the common forms of cryptogams without microscopical examination, and even the stages of development in which they are. It must, however, be remembered that experience fraught with many a failure is the best instructor, but also that a few remarkable successes in obtaining rare algae will make the collector and grower of these plants feel more than repaid for his efforts.

Birds Found in St. Joseph Co., Ind., Each Day in June, 1909.

BROTHER ALPHONSUS, C. S. C.

As May is the month when most of the birds migrate northward, so June is the nesting time for most of them. And as more species are seen during their migrations than may be found in any one locality when the nesting season begins, the total number of species seen will be considerably smaller in June than in May.

Certain species are usually found in land of a peculiar character. The Red-winged Blackbird, Maryland Yellowthroat and Long-billed Marsh Wren inhabit marshy places near lakes or rivers. Purple Martins nest in towers or boxes. As towns furnish these birds with suitable nesting places, they are seldom seen in the country until about the first of July. Cedarbirds and Goldfinches wander about a great deal until they begin to nest in July.

The birds found by the writer during June are most of the summer residents of the county and vicinity. For two successive summers the writer saw a pair of Rose-breasted Grosbeaks nest in a maple tree near a house in the country, but this year he has not seen a single specimen since May 12. The Downy Woodpecker, a common bird in this county from July to March, disappears as spring approaches.

Birds seen every day:

Chipping Sparrow	House Wren
Song Sparrow	Wood Pewee
Warbling Vireo	Robin

Birds not seen during the month:

Hairy Woodpecker	Whip-poor-will
Downy Woodpecker	Scarlet Tanager
Rose-breasted Grosbeak	Alder Fly catcher
Chickadee	Yellow-legs
Bobwhite	Bittern

Birds seen every day except on the dates after their names:

Chimney Swift, 6, 11.
Yellow-billed Cuckoo, 5.
Blue Jay, 13.
Cowbird, 6, 11, 15, 28.
Meadowlark, 5.
Orchard Oriole, 23, 26.
Purple Grackle, 2, 11, 26.
Field Sparrow, 2, 3.
Vesper Sparrow, 4, 7.
Catbird, 8.
Bluebird, 1, 4, 5, 6, 7, 20, 24.
Spotted Sandpiper, 4, 6, 22.
Dickcissel, 1 to 8, 19, 11, 13, 14.
Red-headed Woodpecker, 6, 25.
Kingbird, 4, 11.
Crow, 1, 3, 7, 13, 27.
Red-winged Blackbird, 1, 3, 5, 6, 7, 8, 10, 11, 12, 13, 23.
Baltimore Oriole, 26.
Goldfinch, 2, 3, 5, 9, 13, 15, 27, 28.
Barn Swallow, 3 to 9, 20.
Brown Thrasher, 6, 9, 14.
Mourning Dove, 2, 3, 6, 9, 10, 20.
Flicker, 1 to 7, 11, 13, 14.
Indigo Bird, 1, 3, 6, 9, 10, 11, 12, 13, 16, 17, 18.

Birds seen on the dates after their names:

Owl, 5.
Hummingbird, 7, 8, 20, 28.
Bobolink, 9, 12, 13, 17 to 20, 22, 26, 27.
Cardinal, 22.
Cedarbird, 3, 18, 24, 26, 27.
Yellow Warbler, 9, 13 to 22, 26, 27.
White-breasted Nuthatch, 4, 6, 7, 9, 12, 13, 19, 20, 28, 29, 30.
Purple Martin, 24, 25, 28, 29, 30.
Swamp Sparrow, 1, 14, 20, 21, 23.
Redstart, 2.
Long-billed Marsh Wren, 22.
Belted Kingfisher, 2, 3, 7, 8, 12, 17, 20, 27.
Crested Flycatcher, 2, 3, 4, 5.
Yellow-throated Vireo, 8, 7, 14, 15, 17.
Towhee, 2, 19 to 22, 24, 26.
Red-eyed Vireo, 1, 2, 3, 6, 15, 19 to 23, 25.
Maryland Yellowthroat, 20, 21, 22, 25, 26.
Nighthawk, 19, 25.
Kildeer, 2, 4, 11, 12, 15, 17, 20, 21, 22, 25, 26, 28, 29.
Loggerhead Shrike, 2, 5, 14, 19, 20, 21, 23, 26, 30.

Number of species seen each day:

June	1, 27	June	16, 27
"	2, 34	"	17, 35
"	3, 25	"	18, 34
"	4, 26	"	19, 37
"	5, 26	"	20, 39
"	6, 20	"	21, 35
"	7, 27	"	22, 37
"	8, 31	"	23, 30
"	9, 30	"	24, 31
"	10, 29	"	25, 35
"	11, 29	"	26, 38
"	12, 33	"	27, 35
"	13, 28	"	28, 35
"	14, 32	"	29, 35
"	15, 35	"	30, 34

Total number of species seen, 50.

Some Thalictra from North Dakota.

EDWARD L. GREENE.

The Eastern half of the State of North Dakota, lies well within our Midland Prairie Region. A little to the eastward of the very middle of the state there is presented a geographical feature of

considerable interest. Somewhat to the westward of the most conspicuous group of Dakotan lakes, of which Devils' Lake is largest, there exists a height of land, perhaps some fifty or a hundred miles in length, and possibly here and there almost as broad, which forms a natural barrier separating different water sheds. The trend of this very definite if not greatly elevated barrier is not quite meridional, but inclines to northwest and southeast, and from much below midway of it northward, the streamlets draining the elevation, if from the western slope flow to the Souris River, if from the eastern, to the Red River of the North; so that the major part of the whole drainage is, though by two separate and distinct main channels, tributary to Lake Winnipeg in the far North.

From the more southerly extension of the plateau the streamlets draining it all flow to the Missouri, whether they arise from the eastward or the westward slope of the elevation; and thus this southerly drainage has the Gulf of Mexico for its destination.

Such, in rude outline, is one topographic feature of central North Dakota; and guided by the maps only, the student of plant-evolution and distribution would expect this to be something of a land of promise for peculiar and unusual forms and phases of plant life. It is a region where four different floras might be expected to meet and mingle. To the southward of it lies the western and more arid extension of the great prairies as these occupy eastern and middle Kansas and Nebraska. To the northward are the very different steppes of Manitoba and Assiniboia. Eastwardly lie the alternations of prairie and woodland that make northern Minnesota a region peculiar as it is vast. As closely adjacent on the western side of the plateau is that flora of the northern Rocky Mountains which occupies Montana.

This, I say, is a peculiar district, where several extensive and well marked floras meet and mingle; or, putting the case differently, a kind of neutral ground whence radiate so considerable a number of different phytographic regions.

That this middle section of North Dakota really is such a phytograpically neutral ground has been impressed on my mind strongly by the examination of not a few botanical specimens that have been sent me from there for examination within the last five or six years. Whatever the family or the genus into which sendings fall, I have almost invariably found it difficult, and commonly quite impossible, to name conscientiously the species; this even in such familiar genera

as *Aster* and *Solidago*. Everything has seemed rather notably different from what would be specifically the same thing if it had come from the farther East, or the remoter West, or even from the prairies of Wisconsin, or Iowa or Minnesota.

Not very long since I asked of my friend Dr. J. Lunell, for some time a resident of this interesting region, that he would send me specimens of such *Thalictrum* species as he had collected in North Dakota. Of the specimens which he kindly and promptly sent, there are two which represent species hitherto undescribed; and I more than willingly present herewith my determinations of them all. And when I say more than willingly, I imply that it may be, and ought to be, more than a pleasure to investigate critically any part of any floral district standing thus by geographic limitations aloof from several others, and nothing less than the duty with him who has done so, to make known in how far, and in what manner of specific or varietal departures from more familiar types the membership of each well known genus then presents itself.

THALICTRUM DIOICUM Linn. Under his number 79, Dr. Lunell sends two beautifully prepared specimens from "Thickets, Peninsula of Lake Ibsen, Benson County, 13 June, 1909." I assume that some one of Dr. Lunell's correspondents has referred these specimens to *T. occidentale* for this is the name written on the label. The two specimens belong to different species, and neither is *T. occidentale*. A small plant, not yet in flower, or even in well developed bud at the date, is plainly *T. dioicum*. Its height is only a foot. Its leaves are two only, and both arising from the lower part of the stem. The leaflets are ample and very thin. They are much broader than long, of a semiorbicular outline, and are beautifully and doubly crenate-lobed, all the secondary lobes being equal and very obtuse. These are precisely the marks by which anyone conversant with vegetative characters in this genus recognizes *T. dioicum* when not in fruit. I speak of the species in its broader sense; for this Dakota plant, when its fruit becomes known, might easily prove more or less distinct from the East Canadian type of *T. dioicum*.

Now the second specimen before me under Dr, Lunell's number 79, is not at all the same plant as the other. It is in full flower, or even a little past that stage, at the moment when the other is hardly yet showing its buds. It is much larger, also has numerous leaves up and down its stem, and in the pattern of its leaflets it is altogether diverse from *T. dioicum*. What it is we shall not be like-

ly to ascertain until we have other and more complete specimens, with mature fruit.

Thalictrum thyrsoideum nov. sp.

Planta inter affines humilis, 2—3 dm. alta, caule simplici rigidiusculo, leviter anguloso-striato, sparse folioso, in inflorescentiam nudam subconfertam et thyrsiformem terminante. Folia plerumque 3, non ampla, breviter petiolata; foliola firmiter membranacea, parvula, 11—13 mm. lata, suborbicularia aut interdum late subcuneato-obovata, supra medium 3-loba, lobis 2—3-crenatis, supra glauco-viridia, subtus glauca, utrinque minutim reticulato-venulosa. Sepala maris late ovalia, obtusa, albicantia vel interdum purpurascentia. Sepala feminei iis maris dimidio minora, magis herbacea. Antheræ lineari-oblongæ, acuminatæ. Achenia oblique oblongo-elliptica, sessilia.

This small species inhabits dry prairie about Leeds, where it comes into flower late in May, maturing its fruit early in July. Dr. Lunell has distributed it under the name of *T. venulosum*, but the plant lacks the characters of that species, its leaves being thin and not at all "rugose-veiny" even beneath. Its achenes are nearly twice as long as in that species and much narrower.

The plant which *T. thyrsoideum* most resembles is my *T. campestre* belonging to the high grassy plains of Manitoba and Assiniboia, which is very prominently veiny beneath, and has also the ovate achenes attributed to *T. venulosum.*

Thalictrum Lunellii nov. sp.

Planta dioica fere metralis, caule laete viridi, laevi, glaberrimo, folioso, foliis peramplis; folia omnia subsessilia, pagina superiore saturate viridia, inferiore glauca; foliola magna 4-cm. longa, 3—3, 5 cm. lata, basi et obtusa et subcordata, supra medium late et inequaliter, nec profunde, 7–9-loba, lobis brevibus latissimis obtusis, saepissime cuspidato-mucronatis. Achenia 5–8, brevia, crassiuscula, vix compressa, oblique ovalia, circa 6 mm. longa, apice acuta, turgide 8-costata.

This fine species, belonging to the group *T. dioicum*, *confine* and *occidentale*, was collected in July of this year (1909), in moist thickets of the Souris River near Minot, North Dakota, by Dr. J. Lunell.

Any one acquainted with the geography of North American botany would naturally expect that a new *Thalictrum* from the

Souris Valley would by character indicate relationship to some Rocky Mountain species like *T. Fendleri*, rather than to any member of the genus which is of the remoter Atlantic or Pacific slope of the Continent. But *T. Fendleri* has definitely compressed achenes, with comparatively thin pericarp, of peculiarly oblique or one sided outline; and the nearest kindred of our new type from North Dakota, are the species first mentioned. It is not in near contact with *T. occidentale*, a species of Vancouver Island and adjacent coastal regions, for that, according to Dr. Gray who first published it, has slender achenes a half-inch long. The short plump achenes of *T. Lunellii* proclaim its nearer affinity for *T. confine* of extreme northern New England; from which the Dakotan species differs by its larger, comparatively thicker, and quite turgescent achenes, as well as by its ample foliage of large leaflets quite differently cut.

Thalictrum vegetum nov. sp.

Planta e grege *T. polygami*, illi magis vegeta, licet humilior. Caulis atrovirens, striatus, fere usque ad inflorescentian foliosus, apicem versus pilis brevibus plus minus appressis sparsim obsitus. Folia caulina ampla, circa 3 dm. longa, petiolis leviter, petiolulis magis crebre, hirtellis; foliola maxima, saepissime 5—6 cm. longa; circumscriptina late obovata supra medium late trilobata, lobis obtusis, plerumque integris, mediano interdum inaequaliter trilobo; foliolorum textura membranacea, pagina superiore saturate glauco-viridi, sparsim pubigera, inferiore glauca et plus minusve tomentulosa. Filamenta alba licet basi capillaria, et omino pendula; anthera linearia, fere aeque longa ac filamenta, acute mucronata: panicula fertilis contracta, ramulis, pedicellis calycibusque pilosiusculis. Achenia immatura breviter hirtella.

The specimens of this new ally of *T. polygamum* were collected in the years 1902 and 1905, at Devil's Lake, North Dakota, by Dr. J. Lunell, who remarks that this plant comes into flower from four to six weeks later than the other Thalictra of this region. All his specimens were taken in July; and those of the fertile plant with fruit not yet mature, were gathered in the middle of that month.

The points of contrast btween this and our southern *T. polygamum* are several and well marked.

The plant of the Middle States and southward, while often gigantic in stature—frequently six and seven feet high—is in as-

pect quite thin and spare, because the foliage is remarkably small and far apart, and the flowering branches are equally remote, and are almost horizontally spreading. Thus what one must technically denominate the panicle of *T. polygmum* is sometimes a yard high and almost two feet wide, and so loose and open as seem no panicle at all. At an opposite extreme from this is the small congested panicle of *T. vegetum*, while its yard high stem is closely invested with ample leaves, the single leaflets about two inches long and very broad. On such very marked vegetative differences alone, in default of other characters, the two species would be held distinct, without need of mentioning that the southeastern plant is glabrous, the northwestern one pubescent. But while the stamens of all Eastern *T. polygamum* consist of a firmly upright clavate filament and a very short merely oval anther, those of *T. vegetum* have filaments which are capillary and therefore pendulous, the anthers being thinner, and of four times the length of those of the eastern ally.

The pubescence of this plant of North Dakota, extending as it does to the calyx, and even to the carpels, might cause one to question whether this might not be the long neglected and forgotten *T. dasycarpum*. This particular species has been recently a subject of careful field study by me in its native wilds; for it is plentiful in southern Michigan and far eastward into Ontario, where it seems to take the place of the real *T. polygamum* of the Middle States. Though a small plant compared with that, *T. dasycarpum* has the floral characters not at all of the northwestern *T. vegetum*, but of *T. polygamum*; that is to say, its filaments are clavate and erect and bear short oval anthers, all as in the southeastern species, from which it is distinguished as well by its different habitat and small size, as by its pubescent foliage, pilose pedicels and sepals, and more or less hairy carpels.

Though truly and thoroughly akin to *T. polygamum* there is nothing in the specimens of *T. vegetum* that are before me to indicate that the species is other than dioicous; but further observation in the future may possibly reveal it as more or less polygamous.

Washington, D. C.

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The Economic Value of Birds.

F. J. WENNINGER.

It is a matter of common observation that a great many of our birds are becoming more scarce each year, so much so that a few species are even now on the verge of extinction. Each succeeding year brings with it a new crop of eager sportsmen "anxious to kill and ambitious to make records." But the time has come when the small boy with his rifle and the hunter with his gun must be taught that henceforth all birds must be protected or they will be exterminated.

At the request of the New York Zoological Society, Mr. Wm. T. Hornaday, made a careful study of bird-life in the United States with special reference to its increase or decrease during the fifteen years ending with the year 1898. This was the result: only four states, Kansas, Wyoming, Utah and Washington, showed a slight increase in bird-life; thirty states showed decreases varying from ten per cent to ninety per cent, the general average decrease being forty-six per cent. In Indiana the decrease of bird-life was found to be sixty per cent. That was in 1896. Since then another inquiry has been made and, according to this last report, the volume of bird life has changed so slightly that in 1903, conditions were practically as they were in 1898. Indeed some investigators assert that during the past fifteen years the number of our common song birds has been reduced by one fourth. Another author † claims that "at the present rate, extermination of many species will occur during the lives of most of us. Already the passenger pigeon and Carolina paroquet, only a few years ago abundant, are practically exterminated."

This alarming decrease in the number of birds is due to various

* December 15, 1909.—Pages 105 to 144.

† Chester A. Reed in his Bird Guide.

causes such as winds. snow and wild or domestic animals. But by far the greatest number of birds is destroyed by man himself. Now it is not the purpose of this article to arraign mankind for its barbarity towards birds but merely to show the importance of some of our common birds in the economy of nature and thus point out a few reasons for their preservation.

The great utility of birds lies in their capacity for destroying insects. From time immemorial, man has but feebly combated the insect pest, and it is the birds alone that can check its ravages; hence, destroy the birds and insects will multiply enormously as history only too plainly proves. Much has been written about the destructiveness of insects and economic entomologists are constantly adding new species to the long list of pests that destroy our crops.

The first report of the entomologist of New York,* contains a list of 176 species of insects that destroy apple trees, while the species that destroy plum, pear, peach, and cherry trees are hardly less numerous.

Kaltenbach gives an extensive list of insects that infest the trees of central Europe.† According to this authority, the oak is a prey to 537 species of insects; the elm to 107; the poplar to 264; willows to 386; birches to 297 and beeches to 154.

While the forest destroying insects of our country have not been studied as long as those of Europe some very astonishing discoveries have been made. Dr. Packard ‡ lists over 400 species which are destroying our oaks and expresses his belief that this number represents, perhaps, only one half of the species actually in existence. He places the number of species that attack the hickory at 140; those that ravage the maple at 85; the poplar at 72 and those that live on the pine at over 100 different kinds.

The species of insects which feed on grasses, cereals, field and garden crops are enormous in numbers and each succeeding year adds new names to the list. The loss occasioned by these pests reaches far into the millions of dollars annually. Packard says that "we lose annually by the attacks of insects on agricultural products not far from one hundred millions of dollars."

The Bulletin of the New York State Agricultural Society for the year 1854 shows a loss of fifteen million dollars through the rav-

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* Report of the Commissioner of Fisheries and Game for Ind. Page 980.

† Ibid.—Page 981.

‡ Packard, A. S. Entomology for Beginners. Pp. 191.

ages of the insignificent wheat midge, (*Diplosis tritici*) two years later, in one county of the same state, two thousand acres that would have yeilded 60,000 bushels of wheat were destroyed by the same insect.

The Hessian Fly (*Cecidomyia destructor*) has also caused great devastation in the wheat belt. On the valuation of the crop of 1904, according to statistics furnished by Dr. Marlott, the loss occasioned by this fly alone amounted to almost fifty million dollars while four years previous to that date, the loss in the wheat growing states from this tiny midge approached one hundred million dollars.

Another pest which destroys many of the staple crops in the Mississippi valley is the cinch bug (*Blissus leucopterus.*) The last report of Z. T. Sweeney, commissioner of Fisheries and Game in Indiana, contains statistics of this insect compiled by Drs. Schimmer and Riley. According to this report, the loss caused by the cinch bug in one year, 1864, in the Mississippi valley was one hundred million dollars, while the loss in Illinois for that year reached seventy-five millions.

The cotton industry has a powerful enemy in the ordinary cotton worm (*Alabama argillacea*) which has been known and feared for more than a century. The report of the Massachusetts Board of Agriculture for 1906 says in regard to this pest; "The average loss in the cotton states from this caterpillar for fourteen years following the Civil War was estimated at fifteen million dollars per year.

These are but a few of the striking examples of destruction occasioned by ordinary pests which our birds are destroying. The reports of our boards of agriculture contain numerous cases of insect ravages, not as great as these, perhaps, but still alarmingly large and calculated to make men consider the question of preserving the birds.

When these startling losses are considered it is readily seen how birds operate to prevent injury to our crops. Of course to accomplish this it is necessary that birds be present in sufficient numbers; and yet these numbers need not be very large in proportion to the insects for each bird devours an incredible number of insects. Chester A. Reed says, "It has been found by observation and dissection that a cuckoo consumes daily from fifty to four hundred caterpillars while a chickadee will eat fron two hundred to five hun-

dred insects, or up to four thousand insect or worm eggs.'' The same author has undertaken a very careful study of bird life in Massachusetts and his conclusion is that there are about five insect eating birds per acre in that state. The daily consumption of insects by these 25,600,000 birds, is 2,560,000,000. To the average reader, these figures contain little more than an idea of vastness and for that reason Reed has translated them into simpler language. He says, ''About 120,000 insects fill a bushel measure. This means that the daily consumption of chiefly obnoxious insects in Massachusetts is 21,000 bushels. This estimate is good for about five months in the year.''

The common meadow lark (*Sturnella magna*) has been studied with reference to its capacity for destroying injurious insects and the result has been surprising. The investigation which furnished evidence for the bird's usefulness consisted of a laboratory examination of ''two hundred and thirty-eight stomachs collected in twenty-four states, the District of Columbia and Canada.'' Insect food was found to be 71.7 per cent as compared with 26.5 per cent of vegetable food. In other words, almost three-fourths of this bird's food for the entire year consists of insects. Grasshoppers, locusts and crickets appear to be the usual diet of the lark, the average amount consumed during the year being about 29 per cent of all food. An interesting chapter might be written about the lark as a destroyer of injurious grasshoppers. Here is a calculation from Dr. Fisher. He states that ''the weight of an average grasshopper is 15.4 grains and its daily consumption of food equals it own weight. It is safe to assume that fifty grasshoppers are eaten each day. Now if the number of birds breeding in one square mile of meadow land is estimated at five pairs, and the number of young that reach maturity at only ten in all, there will be twenty birds on the square mile during the grasshopper season. On this basis the birds would destroy 30,000 grasshoppers in one month. Assuming that each grasshopper if left alone would have lived thirty days, the thousand grasshappers eaten by the larks each day, represent a saving of sixty-six pounds of forage a month. If the value of this forage is estimated at ten dollars per ton the value of the crops saved by meadow larks on a township of thirty-six square miles each month during the grasshopper season, would be about three hundred and fifty-six dollars.

But grasshoppers are not the only insects eaten by the lark.

Beetles constitute about 18 per cent of the animal food of this bird. Among the most important of these are the May beetle, (*Scarabaeidae*) a family which contains some of our most injurious insects. In the month of May, 21 per cent of all the food of the Lark consists of these beetles.

Bugs, (*Hemiptera*) and especially those belonging to the family of Stink bugs (*Pentatomidae*) are eaten throughout the year, constituting about 4 per cent of all the food; yet, in May this percentage rises to fourteen.

From the forgoing it will be seen that this bird is pre-eminently an insect eater and hence an important factor in the preservation of our crops. For this reason it should be protected.

The meadow lark is only one of the great army of insect destroyers; other birds are just as useful in this capacity. Even in the apparently destructive career of the crow there are compensations. It is a great feeder on May beetles the larvae of which, known as white grubs, burrow in the ground and devastate grass lands and injure the roots of trees and plants. Robins feed largely on cut worms as well as on the white grub of the Mey beetle. Blue Jays are extremely efficient as caterpillar hunters; warblers, titmice and vireos are hardly less expert. And so on down the long list, we find that each bird has some part in the economy of nature.

The great question is, how can we protect the birds? The game laws of the states are good but the difficulty lies in enforcing them. The remedy lies in education. People must be educated to realize the economic value of the birds. This knowledge, more than anything else, will materially lessen the desire to destroy birds and will preserve one of our nation's most valuable assets.

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Priority of Names of Certain Families of Plants.

J. A. NIEUWLAND.

It seems to be understood that historical priority has become the rule for the acceptance of the names of plant families at least since the year 1753. Some botanical works have begun to mention

or append dates as well as names of authors to whom the family names are to be attributed. I have noted, however, that some of these authors have been antedated, and I herewith give a partial list of such names, mentioning particularly names which conform to the general usage; that is those that end in *aceae*. Should we assume that names of families be accepted such as *Labiatae*, *Leguminosae*, *Umbelliferae*, *Cruciferae* which do not end in *aceae*, possibly a larger list might be obtainable. The best botanists, sanctioned by the rules of the Vienna Congress, approve of the aforesaid names. Many names of families as now accepted are pre-Linnaean in their origin, and forms like *Glandiferae* Caesalpinus, 1583, for the Oak Family, (*Fagaceae*, Drude 1879); *Orchideae* Linnaeus, 1751, for *Orchidaceae*, Lindley, 1836, *Caryophylleae*, Gerard, 1761, *Pomiferae*, Ray, 1682, and C. Bauhin 1623, *Bacciferae*, Morrison, etc., are as old and as acceptable as the names *Leguminosae; Umbelliferae*, *Labiatae*. It seems, however, to be the self assumed privilege of modern botanists to be above all things inconsistent in this matter.

Other systematists have of late discarded the time honored names, *Leguminosae*, *Cruciferae*, *Umbelliferae*, *Labiatae* and substituted such of their own names as *Fabaceae*, *Brassicaceae and Lamiaceae*. *Arundinaceae* was used by John Ray, for *Gramineae*, and it conforms to the modern views. *Rotaceae* the older name for *Primulaceae* even since 1753, *Oleraceae*, *Nucamentaeeae*, *and Campanaceae* can not then be reasonably objected,to except that in our ignorance of them we have so long overlooked them. Nothing short of empirical assumption of lawlessness and inconsistency can excuse from the acceptance of such names on the basis of historical priorty even since 1753, the so-called "starting point" in our present ideas of nomenclature.

I give herewith a list of family names giving in parentheses as synonyms the commonly accepted later ones.

(1) *Campanaceae*, Zinn, 1757.*
Also *Campanaceae*, Gerard, 1761.†
(*Campanulaceae*, Jussieu, 1789.)

(2) *Tiliaceae*, Gerard, 1761.†
(*Tiliaceae*, Jussieu, 1789.)

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* Zinn, Catalogus Plantarum Horti. Acad. Agri. Göttengensis, 1757.
† Gerard, L., Flora Galloprovincialis, 1761.

(3) *Ranunculaceae*, Gerard, 1761. †
(*Ranunculaceae*, Jussieu, 1789.)

(4) *Cucurbitaceae*, Linnaeus, 1754.‡
Also *Cucurbitaceae*, Zinn, 1757.* and Gerard 1761.†
(*Cucurbitaceae*, B Jussieu, 1789.)

(5) *Dipsaceae*, Zinn, 1757.*
Also *Dipsaceae*, Gerard, 1761.†
(*Dipsacaceae*, Lindley, 1836.

(6) *Solariaceae*, Zinn, 1757.*
Solanaceae, Gerard, 1761.†
(*Solanaceae*, Persoon, 1805.)

(7) *Cichoraceae*, Zinn, 1757.*
Cichoraceae, Gerard, 1761.†
(*Cichoriaceae*, Reichenb, 1831)

(8) *Papilionaceae*, Linn, 1754. ‡
(*Papilionaceae*, Gerard, 1761.†)
Papilionaceae, Linn, 1764.)

(9) *Liliaceae*, Zinn, 1757.*
(*Liliaceae*, Adanson, 1763.)

(10) *Rotaceae*, Linn, 1754.‡
Rotaceae, Zinn, 1757*
Rotaceae, Gerard. 1461.
(*Primulaceae*, Ventenat, 1799.)†

(11) *Holeraceae*, Linn, 1754. †
Oleraceae, Zinn, 1757.*
Oleraceae, Gerard, 1761.†
(*Chenopodiaceae*, Dumortier, 1829.)

(12) *Drupaceae*, Linn, 1754.*
(*Drupaceae*, DC, 1805.)

(13) *Pomaceae*, Linn, 1754.‡
(*Pomaceae*, Linn, 1764.)
Pomiferae, Zinn, 1757,* and Gerard, 1761.†

(14) *Epilobiaceae*, Ventenat, 1799.
(*Onagrarieae*, Jussieu, 1804.)||

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‡ Linne, C. V., Philosophia Botanica, 2nd edition, 1754, pp. 27-36.
|| Ventenat, Tabl. du Reg. Veget III. 1799.

(*Onagrideae*, Dumortier, 1827.) §
(*Onagraceae*, Dumortier, 1829.)

(15) *Utriculariaceae*, Dumortier, 1829.¶
(*Pinguiculaceae*, Dumortier, 1829.)
(*Lentibularieae*, Rich, 1808.)
(*Lentibulariaceae*, Lindley, 1847.)

(16) *Nucamentaceae*, Linn, 1754. ‡
Nucamentaceae, Zinn, 1757.*
(*Ambrosiaceae*, Reichenb, 1828.)

(17) *Asperifoliae*, Linn, 1754.‡
Asperifoliae, Zinn, 1757.*
Asperifoliae, Gerard, 1761.†
(*Boraginaceae*, Lindley, 1836.)

(18) *Umbelliferae*, Zinn, 1757.*
(*Umbelliferae*, B. Jussieu, 1759.)
Also *Umbelliferae*, Gerard, 1761.†

(19) *Columniferae*, Zinn, 1757.*
(*Malvaceae*, Necker, 1770.)

(20) *Orchideae*, Linn, 1754.‡
Orchideae, Zinn, 1757.*
Orchideae, Gerard, 1761.†
(*Orchideae*, Lindley, 1836.)

(21) *Juncoideae*, Gerard, 1761.†
(*Juncaceae*, Ventenat, 1799.)

(22) *Melanideae*, Gerard, 1761,†
(*Violaceae*, DC. 1805.)

(23) *Caryophylleae*, Zinn, 1757.*
Caryophylleae, Gerard, 1761.†
Caryophyllaceae, Reichenb, 1828.

(24) *Cyperoideae*, Zinn, 1757.*
(*Cyperaceae*, St. Hillaire, 1805.)

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§ Dumortier, B. C., Florula Belgica, Staminacia, 1827.
¶ Dumortier, B. C., Anal. Fam., 1829.

Notes on Populus, Plinius.

Ivar Tidestrom.

I. POPULUS ALBA.

The genus Populus as understood by Plinius embraced three species, the concepts of which have in some measure survived to the present day. It is true, however, that the terminology has changed and that the word genus was applied to what is nowadays considered a species, but the Plinian application of the word is after all a right one when judged from a strictly linguistic point of view.

That Plinius understood the species (genera) and grouped these naturally, we may infer from the following citation from Historia Naturalis: *Populi tria genera: alba ac nigra et quae Libyca appellatur, minima folio ac nigerrima fungisque enascentibus laudatissima. alba folio bicolor, superne candicans, inferiore parte viridi. huic nigraeque et crotoni in inventa circinatae rotunditatis sunt, vetustiora in angulos exeunt.* (Plin. Hist. Ch. 16, 23.)

Of the above mentioned species the first two still bear the Plinian names; *Populus alba* and *Populus nigra* respectively. *Populus Libyca* has been cited by many pre-Linnean authors as a synonym of *Populus tremula.*

The name *Populus* is of uncertain origin. In the Slavic languages *P. alba* is known by the name *topol* or *topola;* and it is possible that the Latin name is an adaptation from some Oriental language as the species is held to be a native of Asia. According to Plinius Populus was dedicated to Hercules. This is evident from many passages in the works of the classic writers.

"*Arborum genera numinibus suis dicata perpetuo servantur, ut Jovi Aesculus, Appollini Laurus, Minervae Olea, Veneri Myrtus, Herculi Populus.*" (Plin. Hist. 12.)

That *Populus alba* in particular was dedicated to Hercules we gather from Virgilius and other writers: * * "*Herculea bicolor cum populus umbra | velavitque comas foliisque innexa pependit | et sacer implevit dextram scyphus.*" * * Virg. Aen. 8.

"*Populus Alcidae gratissima, vitis Iaccho | formo*(n)*sae myrtus Veneri, sua laurea Phoebo;*" Virg. Ecl. 7.

In the Greek mythology and literature we meet with *Populus alba* under the name 'Αχερωΐς so called because it was said to have been discovered along the river Acheron. It was also called λευκή by Homer, Theophrastus and numerous other Greek writers. The latter name is still applied to *P. alba* in Greece. Another tradition tells of Leuce, the daughter of Oceanus whom Pluto fell in love with and carried off to the infernal regions, being changed after her death into a white poplar.

In Stapel's Commentaries (Stapel. Theophr. Hist. 217. 1644.) we find the following interesting legend from Theocrites. "*Olympionicus inquit Herculem cum ad inferos descenderet, invenisse circa Acherontem inferni fluvium, nascentem populum albam, eamque ad homines portasse, quam Homerus id circo aeheroida vocavit.*" (Theocrites) "*Narrant ex hac Herculem sibi fecisse coronam, eamque capiti imposuisse. Hinc folii partem superiorem porracei seu viridissimi coloris esse, ita ut nigra propemodum videatur ac propter fuliginem ac caliginem terri fumi obscura adeo facta: alteram vero partem, quae temporibus adhaesit, a sudore abluto exalbuisse.*"

Sibthorp (Fl. Graec. Prodr. 2:260.1813) recorded *Populus alba* from Greece and according to him the name λευκή was still in use.

In the works of Dioscorides we find no description of *Populus alba* but a great deal about its medicinal uses.

That λευκή of the Greeks was identical with *Populus alba* of the Romans there is little doubt:

"*Leucen Romani albam Populum dicunt.*" * * Marcellus Virgilius, Diosc. 14. 1523.

There has been and is still some diversity of opinion as to the identity of *Populus alba*. The name has been applied to a number of forms varying from what we regard as *P. alba* to *P. tremula*. Intermediate between these we have *P. canescens* which latter has been mistaken for the true *P. alba*.

One of the earlier records of *P. canescens* is to be found in the works of Lobelius. It is illustrated in Pl. seu Stirp. Ic. 2:193. 1581 and named *Populus alba minoribus foliis*, while *Populus alba* received the name *Populus alba latifolia*. The illustration of the latter shows leaves characteristic of *P. nivea* Willd. Similar illustrations of *Populus alba* we find in the following works: Lobelius, Stirp. Ob. p. 609, 1576; Matthiolus, Comm. Diosc. p. 136, 1565 and pp. 129, 130, 1598; Dodonaeus, Stirp. His. 823. f., 1583 and 835 f., 1616; Gerard. Herb. 1301. f. l., 1597.

In 1623, Caspar Bauhin distinguished two species of *Populus alba* (C. B. Pinax 429, 1623):

1. *Populus alba majoribus foliis.*
2. *Populus alba minoribus foliis.*

Under the first species Bauhin cites the above mentioned authors while under the latter he refers to the Icones of Lobelius.

In 1737, Linnaeus referred P. alba maj. fol., to his Populus foliis subrotundis dentato-angulatis: subtus tomentosis, while he brought the latter under the species as var. α. He gives the range of the species as follows: "Crescit in Germania, Hollandia, Anglia, Gallia, Italia. (Hort. Cliff. 460, 1737.) In Species Plantarum ed. 2. 1462, 1763, Linnaeus omitted var. α and no reference is made to *Populus alba min. fol.* of Bauhin.

Populus alba α of Haller (Stirp. Helv. 156. 1742.) is apparently the pre-Linnean *P. alba maj. fol.*

"*Varietas α qualem ad Rheni ripam in Alsatia reperi. foliis est hederaceis trilobatis. Pulchra arbor, foliis hinc cum atritate hirsutis. inde niveo tomento obsitis, facile adgnoscitur*" Haller l. c.

The species appears under the name of *Populus alba incana* in Weinmann's Inconographia p. 136. f. a. t. 826, 1745, and the figure is characteristic of *P. nivea*. In Miller's Gardener's Dict. ed. 8, it appears under the name of *Populus major* and in Aiton's Hortus Kewensis 3:405, 1789, as *P. alba β nivea*. It reappears in Willdenow's Berlin, Baumz. 227, 1796, as *Populus nivea* while the name *P. alba* is applied to *P. canescens*. Willdenow describes his species *P. nivea* as follows:

"*Die Blätter stehen wechselsweise, sind gestielt, länglich rund, dreilappig, an der Basis zuweilen mit kleinen Lappen versehen. Die Seitenlappen sind ausgebreitet, endigen sich in einer runden, bisweilen etwas verdünnten Spitze. Die mittlere Lappen ist sehr lang vorgezogen, stumpf zugespitzt, am Rande undeutlich gezähnt, auf der Oberfläche sehr dunkelgrün und glänzend, auf der Unterseite schön blendend weise, mit einem diken Filz überzogen. Der Blattstiel ist rund und weissfilzig.*" "*Die Blätter lassen sich von der ersten Art* [Populus alba Ait. non. L.] *durch die drei tiefen Lappen, und dass blendende Weiss der Unterfläche beim ersten Anblik unterscheiden.*" Willd. Berl. Baumz. 227, 1796.

Willdenow apparently adopted the view held by Aiton. After J. E. Smith had published *P. canescens* (Fl. Brit. 3: 1080, 1804.) Willdenow returned to the pre-Linnean concept of *P. alba*, giving

as synonyms *P. alba majoribus foliis*, Bauh. Pin. 429, *P. alba* Dod. Pemp. 835. *P. alba latifolia* Lob. Ic. 2. p. 193, etc. Under *P. canescens* (Willd. Sp. Pl. 4: 802. 1805) he cites the second species of Bauhin, *P. alba folio minore*.

From the above it is clear that the *Populus alba* of pre-Linnean and later authors is identical with *P. nivea* Willd.—possibly the handsomest of poplars. The illustration in Flora Danica (t. 2182) does not show the very characteristic leaves of the upper branches and the rootshoots.

According to Carl Hartman (Anteck. Linn. Herb. 423) there appears to be one specimen of *P. alba* in the Linnean Herbarium. That this specimen represents the historic species we may conclude since Hartman cites *P. nivea* Willd., as a synonym of *P. alba* L. (See Skadin. Fl. ed. 10. 187, 1870.) The synonymy of *Populus alba* so far as we have been able to ascertain is:

Populus alba Matth. Comm. Diosc. 136, 1565. Dodon, Stirp. Hist. 823, f., 1583; Camer. Epit. 65, 1586; Tabern, Kräut, 3: 72. 1591; Jonst. Dendr. 437. t. 123. f., 1662; L. Hort. Clif. 460, 1737; Sp. Pl. 1034, 1753; Willd. Sp. Pl. 4: 802. 1805. Reichenb. Icones Fl. Ger. 11: 29. t. 614. 1849.

Populus alba latifolia Lob. Icon. 2: 193, 1581.

Populus alba majoribus foliis C. Bauh. Pin. 429, 1623.

Populus alba α Haller, Stirp. Helv. 156, 1742.

Populus alba incana Weinm. Iconogr. 136. t. 826. f. a. 1745.

Populus major Mill. Gard. Dict. ed. 8. 1768.

Populus alba β nivea Ait. Hort. Kew. 3: 405. 1789.
Wesm.: D. C. Prodr. 16: 324. 1868.

Populus nivea Willd. Berl. Baumz. 227, 1796.

Description: "*Rami horizontales. Fol. subrotundo-ovata, angulato-dentata, ramulorum terminalium multo maiora, cordata, palmato-5-7-loba, dentata, omnia sicut ramuli petioliquc albissima. Amenta ovata, squamae apice fissae, ciliatar.*" Schmitz & Regel. Fl. Bonn. 150, 1841.

This handsome tree is readily recognized by its horizontal branches, its light gray bark and angular leaves. While in *P. canescens* the bark has a greenish-gray tinge. In *P. alba* there is scarcely a trace of yellow or green. When allowed to spread the lower branches are horizontal and the tree is broader than high. The leaves of the rootshoots and the uppermost branches are

(From Lobelius, Icones, 1581)
PLATE VI. TIDESTROM on POPULUS.

B. P. canescens

C. P. alba Bolleana

A. P. alba

PLATE VII. TIDESTROM on POPULUS.

characteristic of this species: they are dark green above and densely white tomentose beneath, cordate or truncate, obscurely 5-parted,—three lobes prominent, and the two basal lobes small, unequally serrate, 8-10 cm. or longer, and somewhat broader. The normal leaves are smaller, ovate, cordate, cordate-angular or rotund, 4-6 cm. long and somewhat narrower, white tomentose when young, canescent in age. Branchlets and buds more or less white tomentose. Pistillate catkins 5-8 cm. in length; flowers crowded, olive colored, style very short: stigmata filiform, lobed. I have not observed any male trees in America. The species is found in cultivation in the Mormon settlements in Utah and Idaho. There are several trees about an abandoned nursery near Washington, D.C.

Populus alba as we understand it, is a strikingly handsome tree. The clear gray bark of trunk and branches, the dark green upper and the "snow white" nether face of the leaves produce an effect which no other poplar can do, with the exception perhaps of our American Quaking Aspen after a frost.

II. POPULUS CANESCENS.

This species has been referred to above. That it was embraced in the earlier concept of *P. alba* there is little room for doubt as there are more characters in common between *P. alba* and *P. canescens* than between the latter and *P. tremula*. *P. canescens* appears to occupy a mean position between *P. alba* and *P. tremula*, and although its claim to specific rank has been disputed by many its different aspect would entitle it to be classed as a species. It is difficult to distinguish the normal leaves of *P. canescens* from those of *P. alba* as they vary very much in both species both as to form as well as to pubescence. The leaves of the rootshoots in *P. canescens* vary from cordate-ovate and somewhat 5-lobed to nearly orbicular with variously indented margins,—crenate to irregularly dentate. The branchlets are sometimes canescent but usually glabrous and of a rich chestnut color.

As noted above the uppermost branches and rootshoots in *P. alba* bear the large 3-lobed, tomentose leaves so characteristic of the species. In *P. canescens*, on the other hand, the large abnormal leaves are found principally on the rootshoots, if my observations prove correct. The principal synonyms of this plant are:

Populus alba minoribus foliis Lobel. Icon. 2:193. 1581. C. Bauh. Pin. 429. 1623. Weinm. Iconogr. 136. t. 826. f. B. 1745.

Populus foliis subrotundis, etc. var. *ν* Linn. Hort. Cliff. 460. 1737.

Populus alba β Haller. Stirp. Helv. 156, 1742.

Populus alba α canescens Ait. Hort. Kew. 3: 405. 1789.

Populus alba Willd. Berl. Baumz, 227. 1796.

Populus canescens J. E. Sm., Fl. Br. 3: 1080, 1804. Engl. Bot. t. 1619. Willd. Sp. Pl. 4: 802, 1805. Reichenb Icones Fl. Germ. 11: 30, t. 617, 1849.

Populus albo-tremula Krause, Jahrb. Schles. Gesell. 130, 1848; Wesm. in D. C. Prodr. 16: 2 pt. 325, 1858.

The gray Poplar is found extensively in cultivation: it is readily recognized by its greenish gray bark and thick branches. The latter usually stand at an angle of 60° more or less from a vertical line. In this respect *P. canescens* differs much from the true white Poplar.

III. POPULUS ALBA BOLLEANA.

Populus alba var. Bolleana. Masters, Gard. Chron. 18:556. f. 96, 1882.

This form is found occasionally in cultivation. I have observed several trees about Washington, D. C. where Dr. E. L. Greene called my attention to them. The color of the bark of trunk and branches approach nearly that of *P. alba.* The normal leaves are ovate-acute, 5-8 cm. in length, irregularly dentate or sometimes lobed; the leaves of the rootshoots are much larger than in the true *P. alba.* These leaves are fully 1 dm. in length and somewhat broader; the five primary lobes are variously toothed, incised or lobed.

Washington, D. C.

Bird Notes.

WALTER L. HAHN.

The following notes have no relation to one another and, in themselves, may be of little value to science. A large number of observations on the changes taking place in our fauna would, however, form a basis for important biological deductions.

No such mass of data exists, party because the observations have not been made on a large scale, but principally because there has been no

ready means of recording them. We are far behind the British people in number of journals of a local nature devoted to natural history, and the writer believes that the *Midland Naturalist* has an important mission to fulfill in serving as a medium for the publication of notes of local interest as well as in the articles of broader scope.

THE RED-SHAFTED FLICKER IN EASTERN SOUTH DAKOTA.

The red-shafted flicker is a resident of the plateau region of western North America, its range extending east to the Black Hills. It was observed October 3, 1909, by Prof. M. F. Hoopes, of the Springfield State Normal School, and the writer about one mile west of Springfield, South Dakota.

Two of the birds were seen flying from a fence to a wooded ravine a short distance away. They were in company with a number of golden-shafted flickers and the difference in color was very noticeable, as they were flying near the ground, in a good light, and at a short distance from the observers. Another flicker of this race was seen on the evening of October 5, flying over the campus of the Normal School. Means of securing the specimens were not at hand on either occasion but there can be no question as to their identity.

CHUCK-WILL'S-WIDOW AT MITCHELL, INDIANA.

Butler's Birds of Indiana says of the occurrence of this bird in the state, "Summer resident in lower Wabash Valley, at least as far north as Knox County. Breeds. In that region it is not uncommon." I know of no published record for any other locality in the state.

During the summer of 1907 one or more pairs of these birds were resident in the woods in the vicinity of University Farm, three miles east of Mitchell. Their characteristic song was heard by the writer nearly every evening during the late spring and early summer. The farmers of the vicinity also noticed it and commented upon its resemblance to the Whip-poor-will. They stated that they had never heard it previous to that year.

IS THE MOCKING BIRD EXTENDING ITS RANGE?

Several facts seem to indicate that the mocking bird (*Mimus polyglottos*) is extending its range and becoming more numerous in Southern Indiana. McAtee* states that it was rare at Bloomington from 1882-1886 and common from 1901-1903. The earliest date on which it was seen during the latter period was March 24, 1901.

The writer also observed the species at Bloomington from 1901-1903 and again in 1908 and believes that it was more abundant during the latter year. Certainly it has extended the period of its yearly residence. Dr. Charles Zeleny, now of the University of Illinois, saw it and heard its song about the last of January, 1906, the exact record being lost.

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*Birds of the vicinity of the University of Indiana, Proc. Ind. Acad. Science, 1904, p. 157.

The writer identified it at this station February 19, 1908, and it became common that year before the end of March.

In southeastern Indiana this species has been recorded as a rare summer resident. I am unable to say positively whether it occurred on the farm where I lived during the decade ending with 1899, but it certainly was not common. It has increased in numbers steadily during the past six years or more and is now one of the most abundant, and certainly one of the most conspicuous birds of the vicinity. During a visit to the old farm in the latter part of June, 1909, mocking birds were seen in trees of ripening cherries more frequently than any other species. One pair was nesting in a grape arbor not more than ten yards from the door of the farm house and nearer than that to a much used walk. Another pair had a nest in the garden only a short distance from the first. Other nests were not located although there were more than two pairs of the birds in the immediate vicinity.

They were also seen at several places from one-half mile to three miles from the farm mentioned above.

A Boulder of Jasperite.

A. M. KIRSCH.

South Bend, Indiana, is a most interesting locality with reference to the glacial period in Geology. It is here that three great lobes of ice terminated, viz: the Lake Michigan Lobe, the Saginaw Lobe and the Erie Lobe; and for this reason, we find here rock material mingled from three very far removed localities.

The northern edge of the Erie Lobe piled up the moraines represented by the hills which run parallel with the St. Joseph River between South Bend and Mishawaka, and run almost in a straight line east and west. The material for this lobe was brought here from Ontario, Canada.

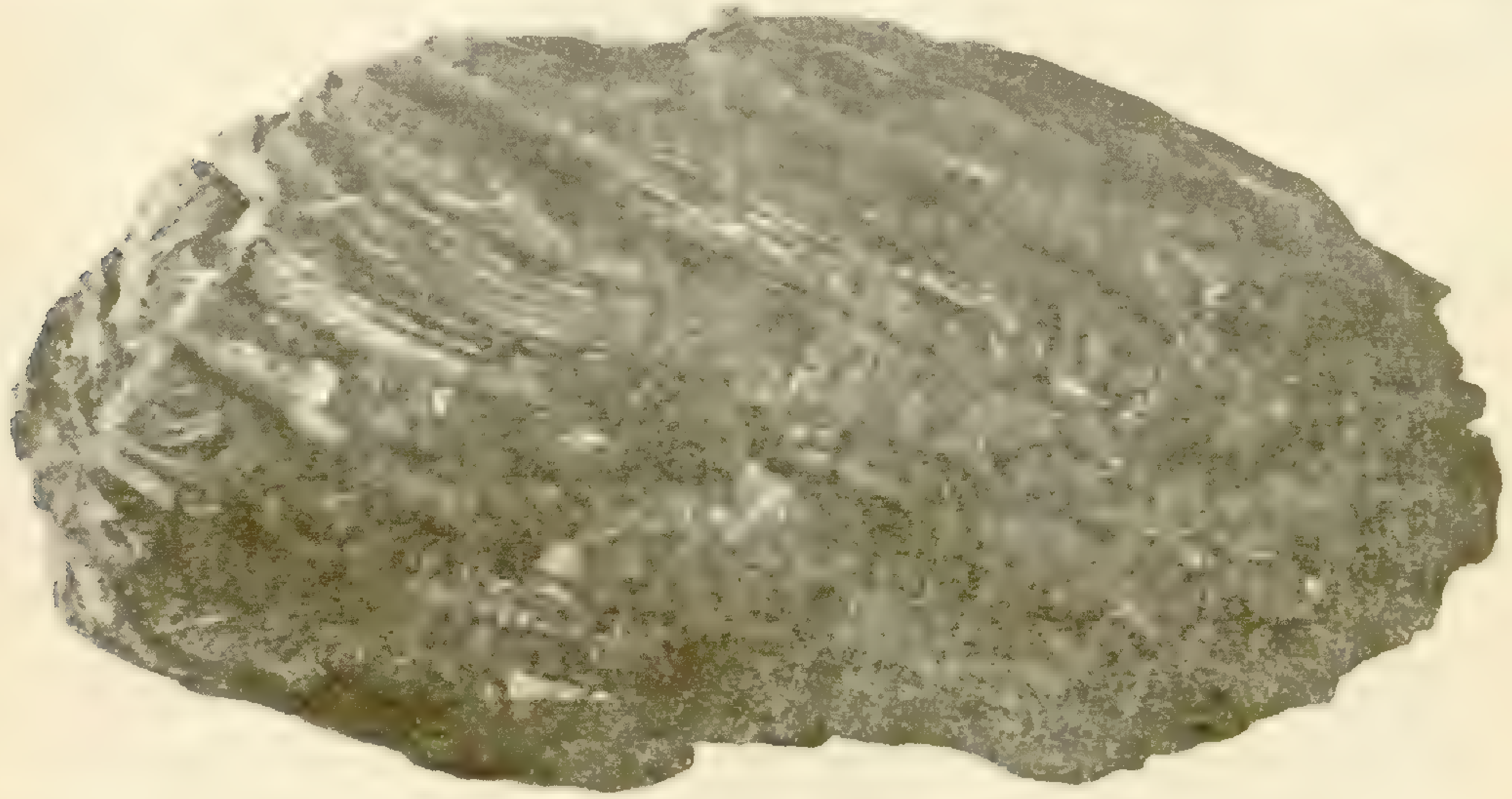
The Saginaw Lobe terminates north of the St. Joseph River, about two miles northeast of South Bend and one mile east of Notre Dame University. Its material was brought here from northeastern Michigan and vicinity.

The Lake Michigan Lobe piled up the hills lying to the west of the St. Joseph River. They may be seen best near Bertrand on the Indiana-Michigan line, some four miles northwest of Notre Dame; by remnants, these hills can be traced southwards as far as a point west of St. Mary's Academy, one mile west of the University.

Different kinds of soil may be found within a radius of a few miles of Notre Dame; in the same gravel-pit even, there may be found boulders or pebbles brought here from the north, northeast or northwest, and commingling of this material has given to this locality a soil which is a puzzle to the uninitiated. The flora and in particular the plant species

are largely determined by the soil on which they grow. Those species which we find here had a mighty struggle in adapting themselves to such strained conditions. It is no wonder, therefore, that the experienced botanist finds this locality full of contradictions. The fact is, our flora is not as yet completely adjusted to the soil. Dr. Edward L. Greene, a most experienced field botanist, spent three weeks here last May (1909), to solve some of the puzzles of the northern Indiana flora. He made some very interesting discoveries which he will, no doubt report in due time.

If I may be permitted a few personal observations in this matter, I may state that for twenty-five years during which I conducted classes of botany, most of the time, I had to offer explanations for the discrepancies in the descriptions of the species in Gray's Manual. Most of the species did not harmonize with the descriptions in the manual. A boulder of Jasperite, found here some years ago, explains to some extent the cause of this confusion. It was found here in Northern Indiana commingled with



material brought here from an entirely different region.

Jasperite is only obtained in Lake Superior region, and this piece from Indiana commingled with material from Ontario, Canada and from Michigan is a clue to the complex soil of northwestern Indiana.

Louis V. Pirsson, "Rocks and Minerals," Pp. 396, defines Jasperite as "a name given to....rocks which consist of layers of red chert (jasper) and hematite. They occur in the Lake Superior region. See page 297." And then he continues: "Jasper is a chemically precipitated opaline silica. In places, as in the Lake Superior region, the jaspers are strongly ferrugineous and interlaminated with bands of hematite. They constitute rock-masses of considerable size, affording valuable deposits of iron ore. They are called Jasperite. The cherty (jasper) layers are colored bright red by the iron oxide." From the accompanying illustration, the difference between the two layers will be easily seen. We add here some of the physical properties of the specimen.

Size. The specimen is 24.1 centimeters long and 12 centimeters wide, with a circumference of 61 centimeters in the length and 42 centimeters in the breadth.

Shape. As seen from the illustration it is approximately oval, resembling somewhat an exaggerated oval pebble.

Hardness. Jasper has a hardness of 7. and Hematite one of 6., average 6.5.

Weight. In air it weighs 6 kilos and in water 4.4 kilos; hence its specific gravity is 3.75.

Erosion. The rounded form and absence of sharp corners shows that our specimen was transported from a distance; and this distance must have been considerable judging from the hardness of the rock. As this particular kind of rock is found only in its native locality about Lake Superior; and this specimen was found in northern Indiana, the obvious conclusion is that it was transported to the latter place by some agent. The natural transporting agents are air, water and ice. It must have been brought here by ice during the glacial period. Its present size and rounded shape resulted from erosion during the period of transportation. The absolute volume and shape may be inferred from its present condition; it evidently depends on its original size and shape, the distance it has travelled, the time of its journey, the material it encountered in its transit, and finally on the weathering it has undergone.

Weathering. The weathering, and especially the differential weathering is very apparent. The hard jasper stands out in well defined ridges, whilst the softer hematite is marked by deepened furrows. If we knew the relative amount of weathering of jasper and hematite in terms of time, we could calculate approximately the absolute time consumed in the weathering of this specimen. The difference between the ridges of jasper and furrows of hematite would form the basis for the calculation.

Original size. Judging from the hardness of the two minerals, we would infer that the original size of the specimen was not much greater than it is at present. Its companion mineral also much softer during its period of transportation and, therefore, could not reduce the specimen very much by friction and wear.

Average composition. The specific gravity of our specimen of Jasperite is 3.75, hematite has a specific gravity of 5.2 and jasper one of 2.6. Knowing these, we deduce the specific gravity for jasperite in the following manner. Adding the specific gravities of jasper and hematite and dividing by two we get the mean specific gravity for equal proportions. Now if we add 5.2 and 2.6, we get 7.8 and dividing this by two, we have 3.70, which is the specific gravity of jasper and hematite mixed in equal proportions. The specific gravity of our specimen is 3.75 and this minus 3.70 gives us a difference of only 0.05. This shows that our specimen is approximately a mixture of equal portions of jasper and hematite, with a slight increase of the hematite.

I shall add here a few notes on the two minerals of jasper and hematite. Jasper is a variety of quartz and is always amorphous, i. e., never

appearing in crystal forms as is very common with quartz or silica ($SiO2$). It also contains some iron sexquioxide ($Fe2 O3$) and vary frequently some clay, hence its hardness is slightly below that of pure quartz. Jasper is mostly yellow, but it is often found, as in our specimen, of a rich deep red color. This color, so emphatic in our specimen, is caused by heat and the presence of iron—the iron becoming anhydrous and causing the change in color. We learn, therefore, that molten hematite introduced into a quartzose rock, very likely a pure sandstone, and caused the silica to turn into red jasper.

Hematite, from the Greek *Haima*, meaning blood, is so named on account of the red color which this mineral presents especially when scratched. It is commonly called red oxide of iron ($Fe_2 O_3$) in distinction from other common iron ores such as magnitie ($Fe_2 O_4$) and limonite ($2Fe_2 O_3 3H_2 O$) which latter is often called brown oxide. From the formula of limonite it is seen that hematite is derived by dehydration which, as explained above, is caused by heat. A limonite clay mixed with sand or pure quartz will, therefore, turn into jasperite by the application of heat, and this is very likely the genesis of the jasperite of the Lake Superior region.

We may gather many interesting facts of the glacial geology of Northwestern Indiana from this piece of jasperite which explains some of the features of local geography and glacial geology.

Birds Found in Van Buren Co., Mich., from July 4 to August 13, 1909.

BROTHER ALPHONSUS, C. S. C.

July is the month when summer residents among the birds may be seen to best advantage. Most of the young birds are fledged and, with the old ones, form families, which feed together. Birds that have more than one brood are still in song and are, of course, conspicuous on that account. The song season for a number of species, such as the Warbling and Red-Eyed Vireos, Towhee, Scarlet Tanager, Indigo Bird, Song and Field Sparrows, lasts almost through the summer.

In this county the writer saw all but one of the ten species not seen by him in June in St. Joseph Co., Ind. The Rose-breasted Grosbeak was not seen here. The large lakes and swampy land around them, in Van Buren County, enabled the writer to find most of these birds. Seven species seen in St. Joseph County in June were not found here in July. These are: Bobolink, Cowbird, House Wren, Nighthawk, Swamp Sparrow, Loggerhead Shrike and Redstart.

It is interesting to note that a short distance from Bankson Lake, near Lawton, Mich., certain species of birds may be found which are not

residents at the lake. This is due to a difference in the character of the country. Ten miles north, in an immense tract of woodland, the Pilated Woodpecker is seen; while about five miles east, in rich prairie land, the Golden Plover is fairly common.

Birds Seen Every Day.

Red-headed Woodpecker
Wood Pewee
Warbling Vireo
Chipping Sparrow
Song Sparrow
Robin

Birds Seen on Every Day Except the Dates After Their Names.

Yellow-billed Cuckoo 12, 16, 21, 22, 23, 28, 29. Aug. 2, 4, 7, 9.
Kingbird 13.
Crow 5, 16, 21.
Baltimore Oriole 8, 10, 18, 19, 29.
Purple Grackle 5. Aug. 4, 6, 12, 13.
Field Sparrow, Aug. 11.
Indigo Bird 12, 16.
Barn Swallow 20, 21, 26, 28, 29, 30. Aug. 2, 5.
Brown Thrasher 7, 13, 15, 16, 18, 23, 25, 30. Aug. 2, 6, 7.
Killdeer 26, 28. Aug. 4, 5, 10, 11, 13.
Yellow-legs 10, 11, 17, 22, 23.
Spotted Sandpiper 9, 13, 18, 19, 23, 24, 25, 27, 28, 29. Aug. 1, 6, 10, 12, 13.
Mourning Dove 4 to 11, 14 to 18, 21, 22. Aug. 2, 6, 11.
Yellow Warbler 11, 14, 19, 21, 22, 23, 28, 29, 31. Aug. 1 to 7, 9, 13.
Belted Kingfisher 5, 9.
Flicker 8, 13. Aug. 1, 11.
Phoebe 4, 5, 6, 12. Aug. 3, 11, 13.
Red-winged Blackbird 11, 29. Aug. 4, 6, 13.
Goldfinch 15.
Vesper Sparrow 15, 21, 23. Aug. 1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 13.
Maryland Yellowthroat 16.
Catbird 8, 12.
White-breasted Nuthatch 19.
Bluebird 5, 9, 11, 13.
Downy Woodpecker 4, 5, 7, 8, 9, 12, 23, 24, 28. Aug. 7.
Yellow-throated Vireo 4, 5, 19, 21, 22, 23, 25, 27. Aug. 6, 7, 8, 9, 10, 11, 12, 13.
Alder Flycatcher 9, 13, 14, 19, 21, 22, 26, 27. Aug. 12.
Blue Jay 11, 19, 20, 23 to 26, 30. Aug. 4, 5, 6, 8, 10 to 13.

Birds Seen on Dates After Their Names.

Screech Owl 14, 15, 25, 26, 27, 30, 31. Aug. 6.
Hairy Woodpecker 4, 11, 12, 15, 17, 27. Aug. 7, 10, 12.
Chimney Swift 19, 23.
Hummingbird 11, 16, 19, 24, 27.
Meadowlark 14, 19.
Dickcissel 5, 6, 7, 9 to 12, 14, 18.
Scarlet Tanager 4, 5, 7, 14, 15, 19, 20, 24, 27, 29, 31. Aug. 1, 4, 6.
Red-eyed Vireo 4, 5, 7, 12, 13, 14, 20, 24.
Chickadee 7, 13, 14, 17, 20, 24 to 28, 31. Aug. 2, 12.
Chicken Hawk 24.
Cardinal 14.
Black-billed Cuckoo 13, young bird.
Whip-poor-will 4, 6, 14, 15, 16, 19, 22, 25, 30. Aug. 1, 2, 4, 5, 8, 9.
Crested Flycatcher 8.
Orchard Oriole 4, 11.
Towhee 4, 7, 9, 12, 13, 14, 17, 19, 20, 25, 31. Aug. 2, 4, 5, 6, 9, 12.
Cedarbird 4, 8, 23. Aug. 6, 8, 10.
Long-billed Marsh Wren 13, 16, 18, 19, 20. Aug. 2, 3.
Bittern 8, 14, 16, 20, 22, 28, 31.
Purple Martin 17, 19.

Bobwhite 12, 13, 15, 18, 20, 27, 29, 30, 31. Aug. 3, 6, 7.
Eave Swallow 20.
Tree Swallow 23 to 26.
Hell Diver 15. Aug. 13.
Loon 5, 16, 19, 25.
Bank Swallow 9, 10, 13, 14.

NUMBER OF SPECIES SEEN EACH DAY.

July 4, 37.	July 25, 36.
" 5, 30.	" 26, 35.
" 6, 33.	" 27, 36.
" 7, 36.	" 28, 30.
" 8, 32.	" 29, 30.
" 9, 32.	" 30, 34.
" 10, 31.	" 31, 38.
" 11, 31.	Aug. 1, 29.
" 12, 34.	" 2, 33.
" 13, 35.	" 3, 32.
" 14, 42.	" 4, 30.
" 15, 36.	" 5, 31.
" 16, 33.	" 6, 29.
" 17, 36.	" 7, 30.
" 18, 31.	" 8, 33.
" 19, 35.	" 9, 32.
" 20, 40.	" 10, 32.
" 21, 26.	" 11, 26.
" 22, 28.	" 12, 31.
" 23, 27.	" 13, 23.
" 24, 38.	

Total number of species seen, 60.

Notes on the Stemless Lady's Slipper.

EDWARD L. GREENE.

Of these notes, however, I am but the editor, not the author, as will readily be seen. The paper which appeared in the August issue of the NATURALIST called forth from a number of botanical friends and correspondents so much additional information, showing still further diversity in the habitat of *Cypripedium acaule*, that no reader interested in the plant will question the desirability of their being given publicity.

Mr. Charles C. Deam, a zealous Indiana botanist, until lately of Bluffton in the northeastern part of the state, now of Indianapolis, under date of September 5th, writes: "Your article on *Cypripedium acaule* was interesting. I have taken this species in Steuben County, Indiana, from the border of a lake in a tamarack

swamp. It grew as you described it in tamarack conditions, and was fairly abundant. I took perhaps thirty sheets of specimens at this place. One or two of them had two flowers, but I think two-flowered specimens are rather rare."

Not having before heard of such a thing as a two-flowered plant of this species, I wrote to Mr. Deam at once to inquire as to how they were two-flowered; whether with the two flowers on two separate scapes, or, on one two-flowered scape. My correspondent wrote later that he had tried to find his two-flowered specimens and could not; and he was manifestly unwilling to venture a reply to my query without a new look at the plants. Here, then, there is something for future collectors of the plants to look into.

Professor C. F. Wheeler, now of the Department of Agriculture in Washington, but for a quarter-century, more or less, an active Michigan botanist, long time Professor of Botany at the Michigan Agricultural College not far from Lansing, I find very familiar with our Stemless Lady's Slipper as it occurs in the tamarack marshes of south-central Michigan. He informs me that its habitat and associations in that region are quite those which, in my former paper I attribute to it as a denizen of tamarack marshes of the opposite side of Lake Michigan in southern Wisconsin, though with the rather noteworthy difference, that he often gathered it in his Michigan region growing in the very midst of the living sphagnum itself, where, as the plants were lifted, their white roots showed plainly that they had not been in any soil at all, but were supported by the watery-spongy sphagnum. I may here remark that in the larch swamps of Wisconsin, it was in this watery-spongy sphagnum alone that *Arethusa* and *Pogonia* grew but not the *Cypripedium*.

For a good account of some new phases of this plant's ecology I am indebted to two other Michigan botanists, both of them, if I mistake not, former students of Prof. Wheeler.

Mr. H. C. Skeels gives me the following: "*Cypripedium acaule* Aiton, at Grand Rapids, Kent County, Michigan, grows in the dense sphagnum of the tamarack-spruce-cedar swamps; here usually attaining the height of from 12 to 18 inches. It is also found, but not as plentifully, at Mill Creek in the same county, on the summits of sandy ridges, under pine and hardwood trees; about 6 to 10 inches high. In sphagnum pockets at the base of these ridges the tall form is found."

The two most interesting points in Mr. Skeels' account are—first, that at the Mill Creek station that he writes of, the species occurs in two very different conditions, yet in close proximity to each other; for it is a sphagnum bog plant along the base of a chain of hills, and a sandy woods plant a few rods away along the summits of these hills. The second point of deep interest is, that it is here a sand dune plant. The Grand Rapids and Mill Creek region where Mr. Skeels made these ecologic studies, though many miles away from what is the present shore of Lake Michigan is but an ancient beach of the same lake. The ridges on top of which the Lady's Slipper grows are but old sand dunes of the ancient shore, now overgrown with the forest. This Mr. Skeels understands as perfectly as I. He also comprehends as clearly that what he lucidly calls the sphagnum pockets down at the base of the old sand dunes were water pools anciently, until the sphagnum came in and claimed possession. He also assures me that swamp huckleberries grow in the sphagnum pockets quite plentifully, and black huckleberries are a part of the underbrush amid which the plant thrives at the summit. The fact that the plant of sandy ridges is only about half the height of that of the boggy places below is well worthy of remark.

A recent letter from Mr. Charles K. Dodge of Port Huron, Michigan, in which he acknowledges the receipt of my former notes on the species, and also refers to my last spring's visit to Port Huron, says: "I wish you had mentioned to me the *Cypripedium acaule*. It is a sand dune plant in Huron County, Michigan, growing in abundance in shade, between sand ridges, up and down their sides, and all over them; but always in the shade of small trees and bushes. About Port Huron, and across the St. Clair River in Lambton County, Ontario, it is only occasionally found, and in ground that is wet in spring and autumn, but apt to be dry in midsummer. I have never met with it in swamps as stated in books."

On this exceedingly instructive and interesting piece of information I need but remark that Mr. Dodge has for his field the most easterly part of southern Michigan, where the sand dunes are those of Lake Huron; and they are not the dunes of many ages since, but rather recent and close by the lake itself. His west Canadian habitat for it in Ontario, is a part of the same Lake Huron shore district.

Nyssa sylvatica Marsh.

THEO. HOLM.

[*With 16 figures drawn by the author.*]

The genus *Nyssa* is now confined to North America (southern Ontario and the eastern United States), where three species are distinguished, and to southern Asia, where a single species is distributed from the eastern Himalayas to the island of Java. *Nyssa sylvatica* Marsh, *N. Ogeche* Marsh, and *N. aquatica* L. are the American species, familiarly known as Tupelo, Pepperidge, Black or Sour Gum. They are deciduous trees with unisexual flowers, and alternate leaves, and very distinct from *Cornus* and *Garrya*, the only other members of the *Cornaceæ* represented in our country.

While excellent illustrations and very detailed descriptions of these *Nyssae* are to be found in Sargent's Silva of North America there are still some points of interest to be noticed, which have not, so far, been recorded, and which may deserve attention. A comparative study of the three American species would, of course, lead to better results than the consideration of only one of these, but since *N. sylvatica* is the only species occuring in this vicinity, I am compelled to confine myself to this species, hoping that the present notes may serve as a small contribution to the knowledge of this, in many respects, very peculiar tree.

Characteristic of the mature tree is the frequently very broad and flat top, the crowded horizontal to pendulous branches, and the very short, stout, lateral branchlets, not speaking of the bright, crimson color of the foliage in Autumn. The leaves are generally described as entire, in contrast with the frequently remotely and irregularly angulate-toothed ones of *Nyssa aquatica*. Sargent (l. c.), however, states that they are "rarely coarsely dentate", while Bentham and Hooker describe them as "integerrima or juniora lobato-dentata." Of these statements the latter is the more correct.

In studying the foliage of trees, which in many of our native species offers a multitude of forms, especially in regard to outline, it is necessary to include the younger stages, and if possible, the seedlings. Not only is the manner of germinating of some interest, but also the structure and shape of the first leaves succeeding the cotyledons, since these, the so-called primary leaves, evidently repre-

sent the foliage of ancestral types, a point that has been discussed and explained in *Quercus*, for instance.

Now in regard to the *Cornaceae*, *Aucuba japonica* is the only one of which the seedling-stage has been described by Lubbock in his comprehensive work on seedlings, and none are mentioned by Klebs.* In the seedling of *Aucuba* the primary root is stout and fleshy; the hypocotyl is quite long, and the cotyledons oblong-ovate, obtuse, three or five-nerved, shortly petiolate. The first pair of leaves are ovate, while the second and third pairs are reduced to small, subulate scales preceding the ultimate, which are ample, lanceolate-oblong, distinctly serrate-dentate on the upper half, and alternately penni-nerved. In *Cornus florida* † the primary root is rather slender, the hypocotyl erect, and the cotyledons green and foliaceous; the primary leaves resemble those of the mature tree, but are, however, held in a vertical position, and are somewhat narrower than the typical leaves. A very similar structure is represented by the seedling of *Nyssa*, or to be more exact of *N. sylvatica*, since the seedlings of the other species are not known so far. In this species of *Nyssa* (Fig. 1.) the primary root (R) is long, very slender and amply ramified, especially at the base, beneath the hypocotyl (H). This organ, the hypocotyl, is erect, but slender and bears two green, oblong cotyledons, which are obtuse, and approximately five-nerved; (Fig. 2.) the following internodes are stretched, and the leaves of the first season vary from elliptic with entire margins to obovate with the margins dentate. The foliage of the seedling, thus, differs in a marked degree from that of the mature tree, which we remember is mostly oval or obovate, and always with the margins entire. In the second season we meet with a single, erect shoot with remote leaves and with the primary root developed as a strong, very long, deep root; we observed at this stage the same variation in foliage, as a matter of fact it recurs for several years so long as the plant is a mere shrub, but ceases when it becomes a tree. In other words the dentate leaves characteristic of *N. aquatica* occur, also, in *N. sylvatica* before it reaches maturity. It would be interesting to know whether this be the same case of *N. Ogeche*, of which only the entire leaf is recorded.

This peculiar variation in regard to the foliage, with the margins entire or dentate, does not depend upon the position of the

* Untersuchungen aus d. bot. Inst. Tuebingen I: 536. 1881–1885.

† Merck's Report for Dec. 1909.

leaves, and is almost as striking as the well-known heterophylly in *Sassafras*, where lobed and entire leaves appear on the same shoot with no indication of any special arrangement. So far as concerns our *Nyssa* I can only say that the dentate leaves occur occasionally on the seedlings during the first season, that they are very frequent on the young shrubs, where they are equally as common on the long, vigorous shoots as on the short, lateral branches of these; but, so far, I have not observed any such dentation of the leaves on the root-shoots of *Nyssa*. The accompanying figures 3–6 illustrate the foliage of a single lateral branch, of which figure 3 shows the basal, figure 6 the apical of these leaves; figure 7 represents a larger leaf from a tall shrub, and the dentation is very pronounced. It generally appears as if the dentate leaves are larger than the entire; it is, for instance, not uncommon to find dentate leaves measuring up to fifteen cm in length, while the entire on the same branch may reach only nine or ten cm, or much less. Another point, not to be left out of consideration, is the noticeable difference in outline between these two types of leaves. While the dentate are always obovate, the entire vary from lanceolate to oval, obovate, the oval being perhaps the most frequent of the mature tree, and the obovate that of the seedling.

In passing to describe the internal structure of the vegetative organs as observed in *Nyssa sylvatica*, it must be stated beforehand that the stem and leaves of the *Cornaceae* have already been studied by various authors, while the root, as is generally the case, has been neglected. A very complete treatment of the family from an anatomical point of view has been presented by Solereder in his work, *Systematische Anatomie der Dicotyledonen*.* In this treatment, however, the leaf and the stem of the mature tree only have been examined, thus we conceive no comparison between the various stages of growth, and no information about the root-structure. The ample material which I have had the opportunity to study enables me to present some supplementary notes, beside a description of the root-system as represented in the seedling and mature tree. Let us begin with the root.

THE ROOT.

So long as the cotyledons are the only leaves developed upon the seedling the primary root shows a very simple structure, and

* Stuttgart 1899 page 487.

with no indication of increase in thickness. At this stage it is unbranched, and very little hairy. The only peculiarity, which may deserve mention, consists in the presence of a broad pith. Beside that the hadromatic rays are very short and separated by broad arches of leptome; otherwise the structure is very simple. The cortex is homogeneous, there being no exodermis and no stereïds, but about ten strata of thinwalled parenchyma, very compact, and with no deposits of starch. Endodermis is, also thinwalled with the Casparyan spots plainly visible, and the pericambium is continuous represented by a single layer; the stele is tetrarch. Later on when the seedling is at the stage shown in the accompanying figure 1, the root has commenced to branch, and has increased considerably in length. At this stage the internal structure is changed, and to such an extent that the pith and the primordial vessels are the only tissues left intact. Epidermis is now partly thrown off, nearly the whole cortex is collapsed so as to form wide cavities, and the thickened endodermis shows here and there radial divisions. Inside endodermis we notice a broad secondary cortex, developed from the pericambium surrounding a solid stele of collateral mestome–strands and a central pith, at the periphery of which the four primordial hadrome-rays are still to be recognized. Starch was observed in the narrow (one row) medullary rays, but no crystals of calcium oxalate. In regard to the lateral roots, borne upon the primary, the structure agrees with that of the mother-root before the secondary formations set in; these are, however, also capable of increasing in thickness, but much later than the primary.

A still more modified structure occurs in the thick, woody roots of the mature tree. In these all the primary tissues from epidermis to endodermis incl. are lost, but replaced by a heavy coating of homogeneous, thickwalled cork of pericambial origin, which encloses a broad secondary cortex with aggregated crystals of calcium oxalate, deposits of starch, and interspersed with groups of thickwalled, porous sclereïds. The stele is very broad, with numerous wide tracheids, thickwalled parenchyma and libriform; the medullary rays are thinwalled, and consist mostly of a single or two rows of radially stretched cells, containing starch.

While thus the root of our *Nyssa* illustrates the general structure of the dicotyledonous type so far as concerns the primary and secondary stages, the presence of crystals and sclereïds in the secondary cortex is of some interest.

THE STEM.

The hypocotyl, the first internodes of the seedling, the branches of the mature tree, and finally the peduncle of the female inflorescence, these represent portions of the stem of which the structure must be considered in order to obtain a complete view of the internal morphology of this organ. To ascertain the primary structure of the stele the hypocotyl is especially instructive, while the older branches of the tree show us the tissues in their final shape with the secondary formations. In regard to the origin of the secondary mestome-strands, we remember that these most frequently develop from interfascicular cambium, or from a procambium*; however, several and very distinct modifications are known, more so from herbaceous than from woody stems, and some of these structures may be quite complicated. As regards the peripheral tissues these are, also, more or less involved and subject to change, when increase in thickness takes place, hence a comparison between young and mature shoots becomes necessary. In beginning with the hypocotyl of the seedling (Fig. 1), we notice at once that all the peripheral tissues are preserved although the stele shows already a marked increase so as to obscure its primary structure. Viewed in cross sections the stele represents a solid circular zone of leptome, cambium and hadrome enclosing a homogeneous, thinwalled pith, and this structure exists from the subterranean base to the apex beneath the cotyledons. In the basal portion it is very difficult to locate the primary mestome-strands, while toward the apex their position becomes readily noticeable by the presence of stereomatic strands in the pericycle, and by the primary vessels being more distinct, relatively narrow and of a darker color than the others. There are, thus, in all eight primary mestome-strands in the hypocotyl which traverse this parallel with each other and with the surface. But how these primary strands become connected with each other must be studied from a still younger stage than the one figured (Fig. 1.) We must examine the seedling before the cotyledons have ceased to grow, and before the plumule has developed into a shoot of several internodes. At this stage the stele shows very plainly eight primary collateral mestome-strands separated from each other by strata of thinwalled parenchyma (Fig. 8.); or at a

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* Sachs: Lehrbuch der Botanik. Leipzig 1874 p. 113. Haberlandt: Physiol. Pflanzenanatomie. Leipzig 1896, p. 491.

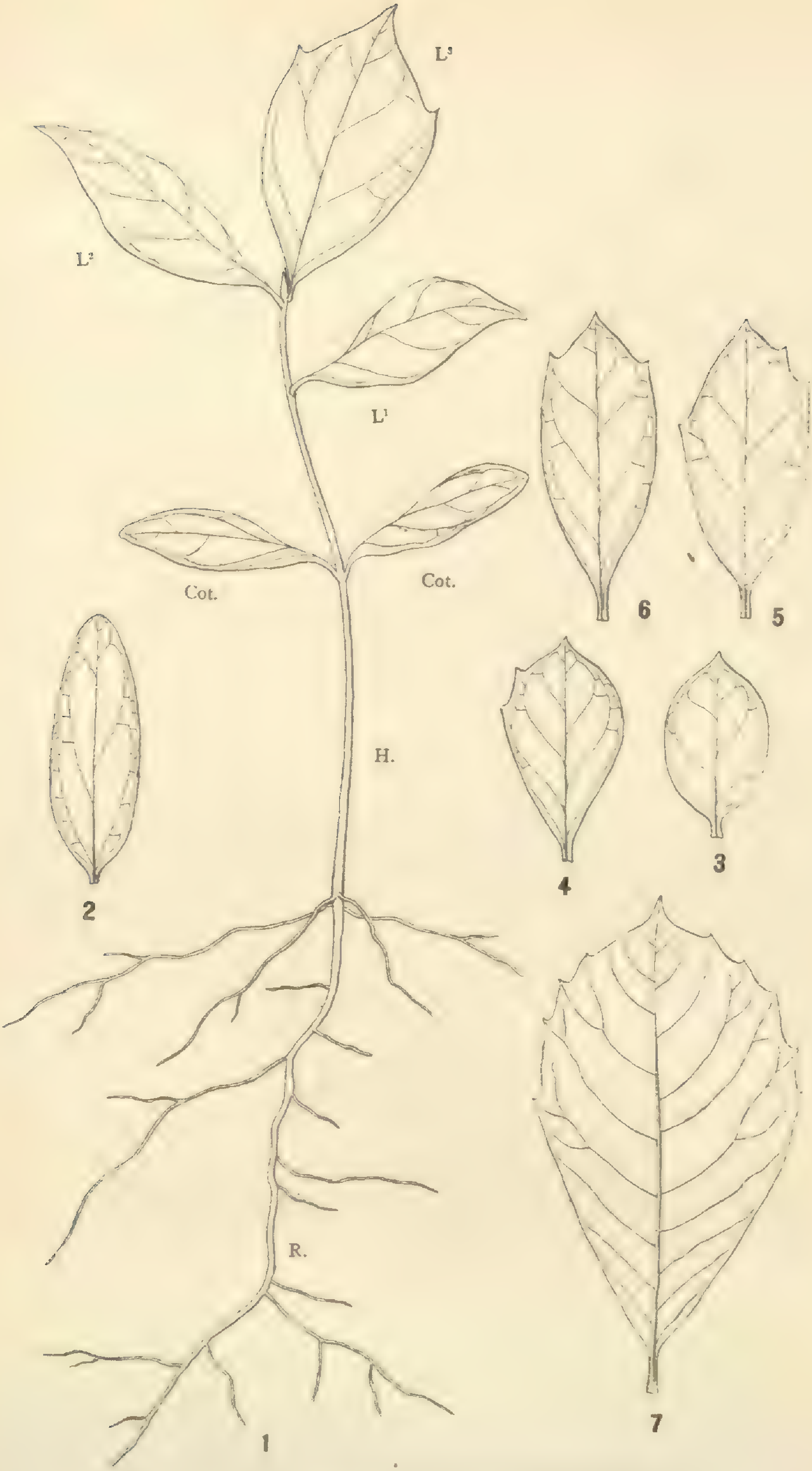
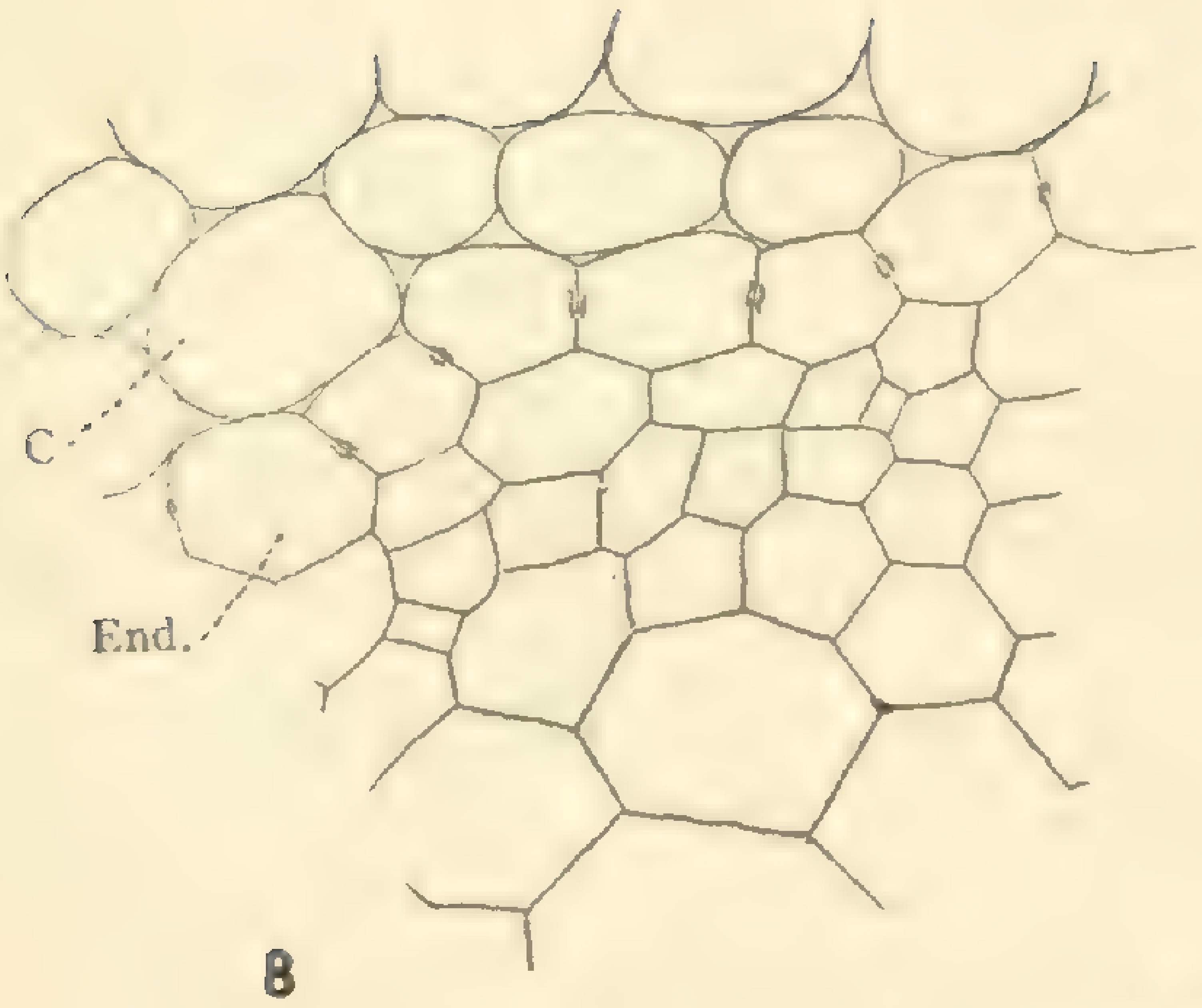


PLATE IX. HOLM on NYSSA SYLVATICA.



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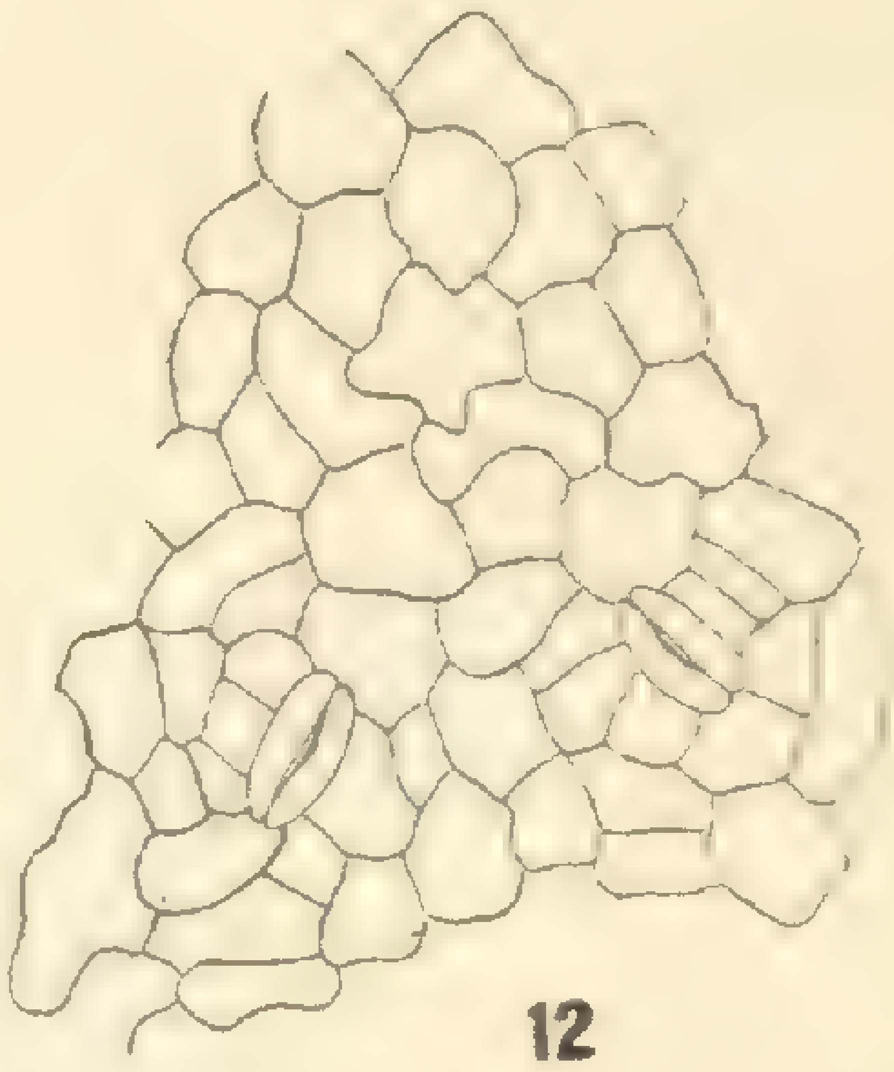

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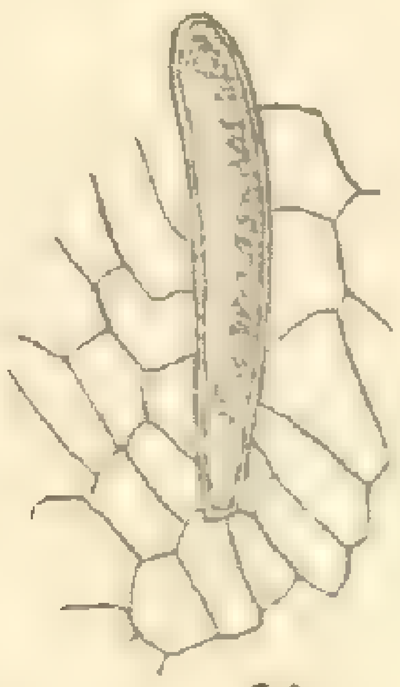

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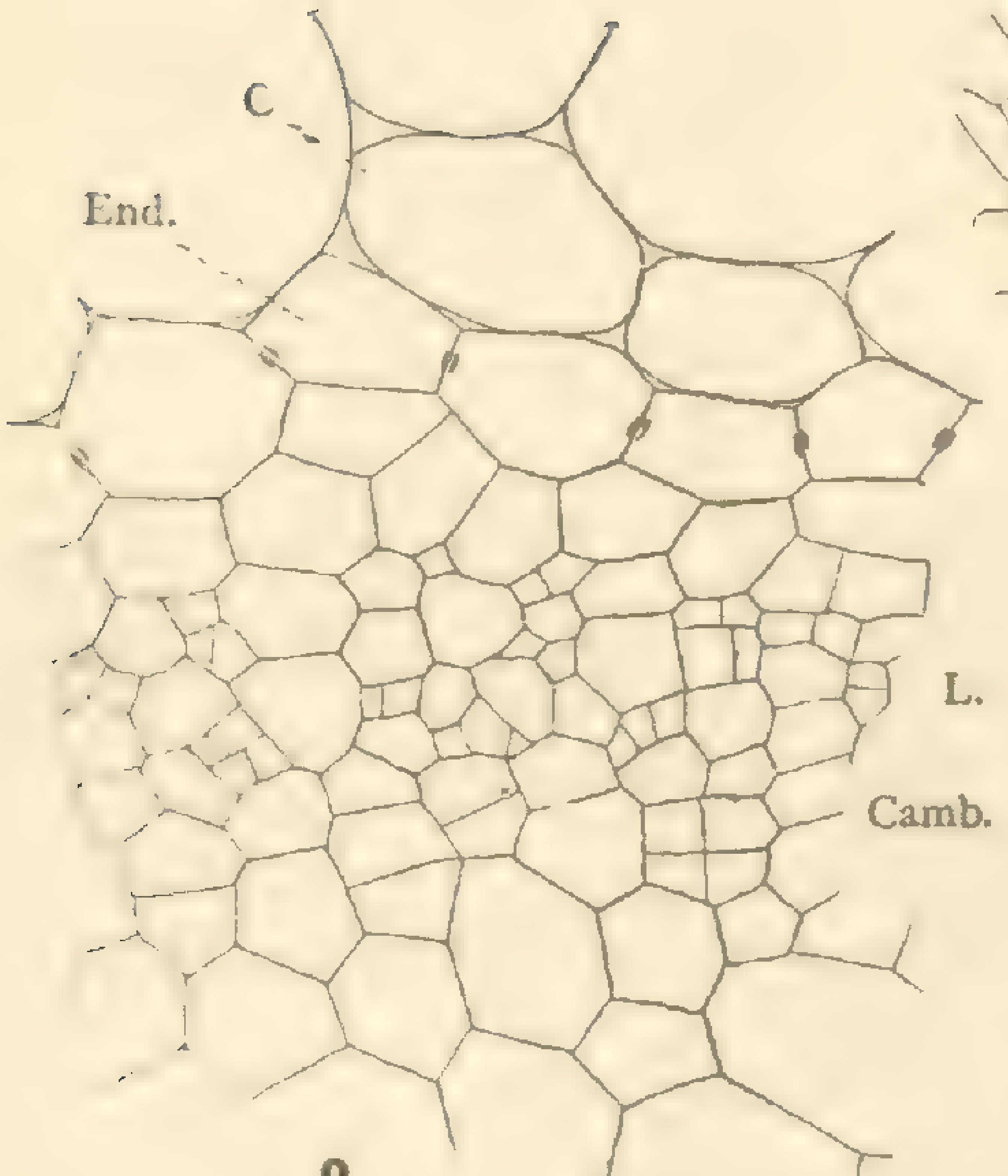

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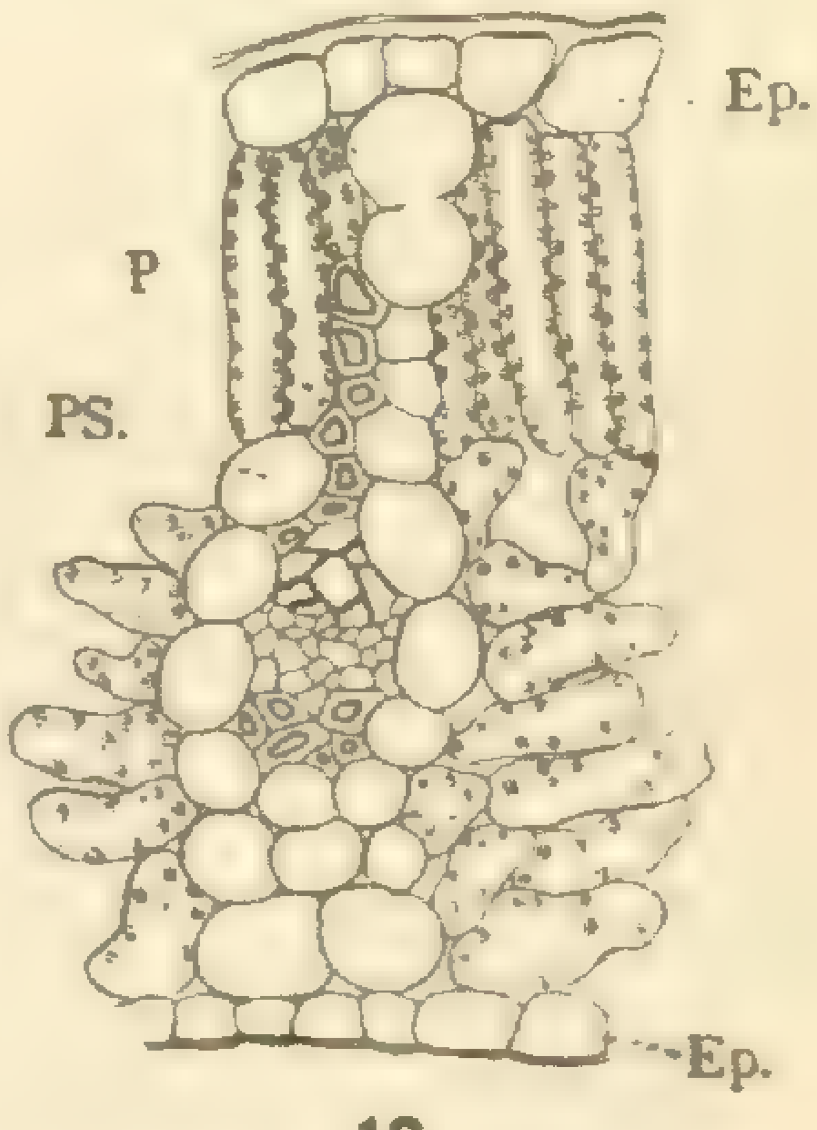

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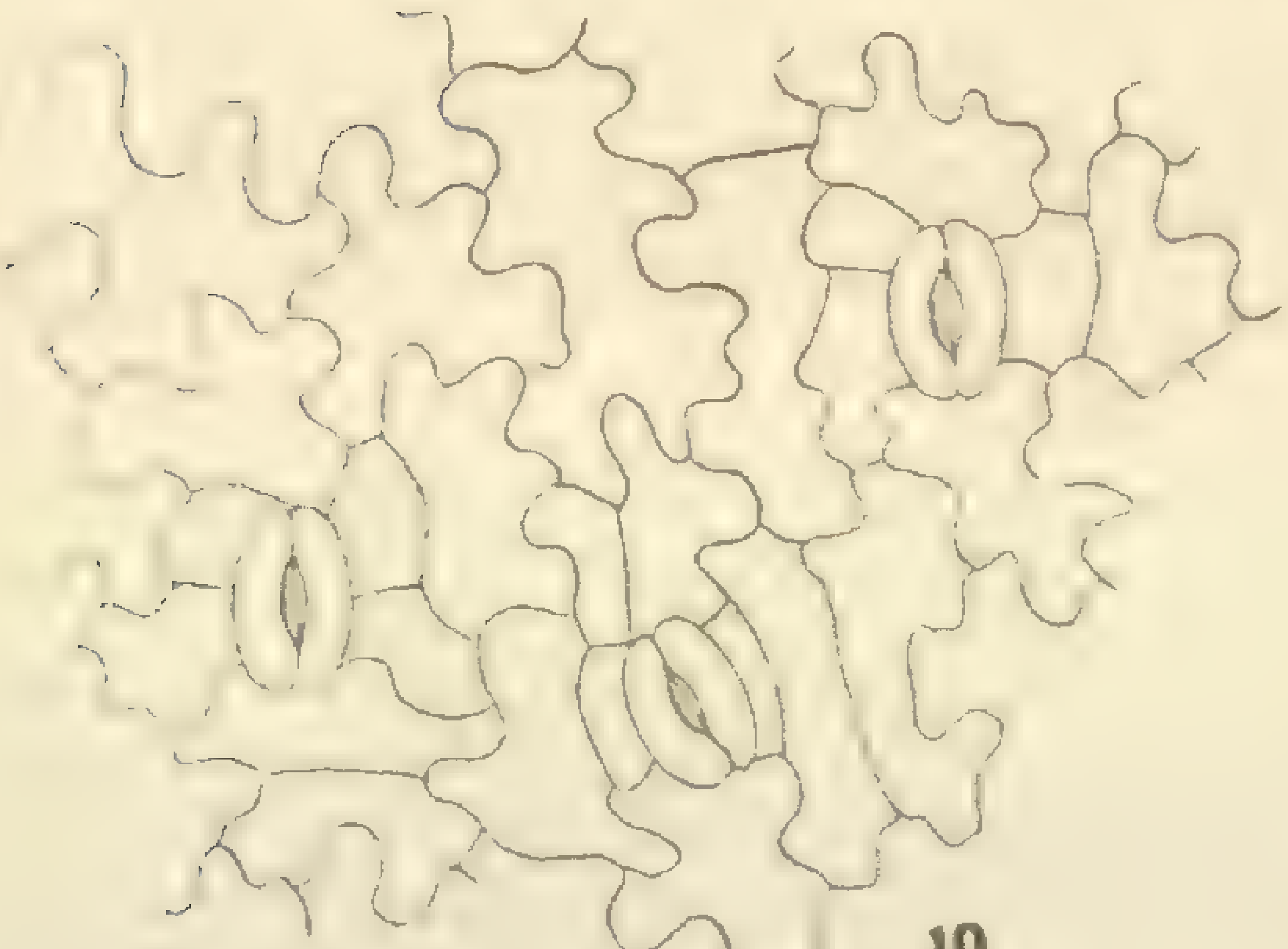

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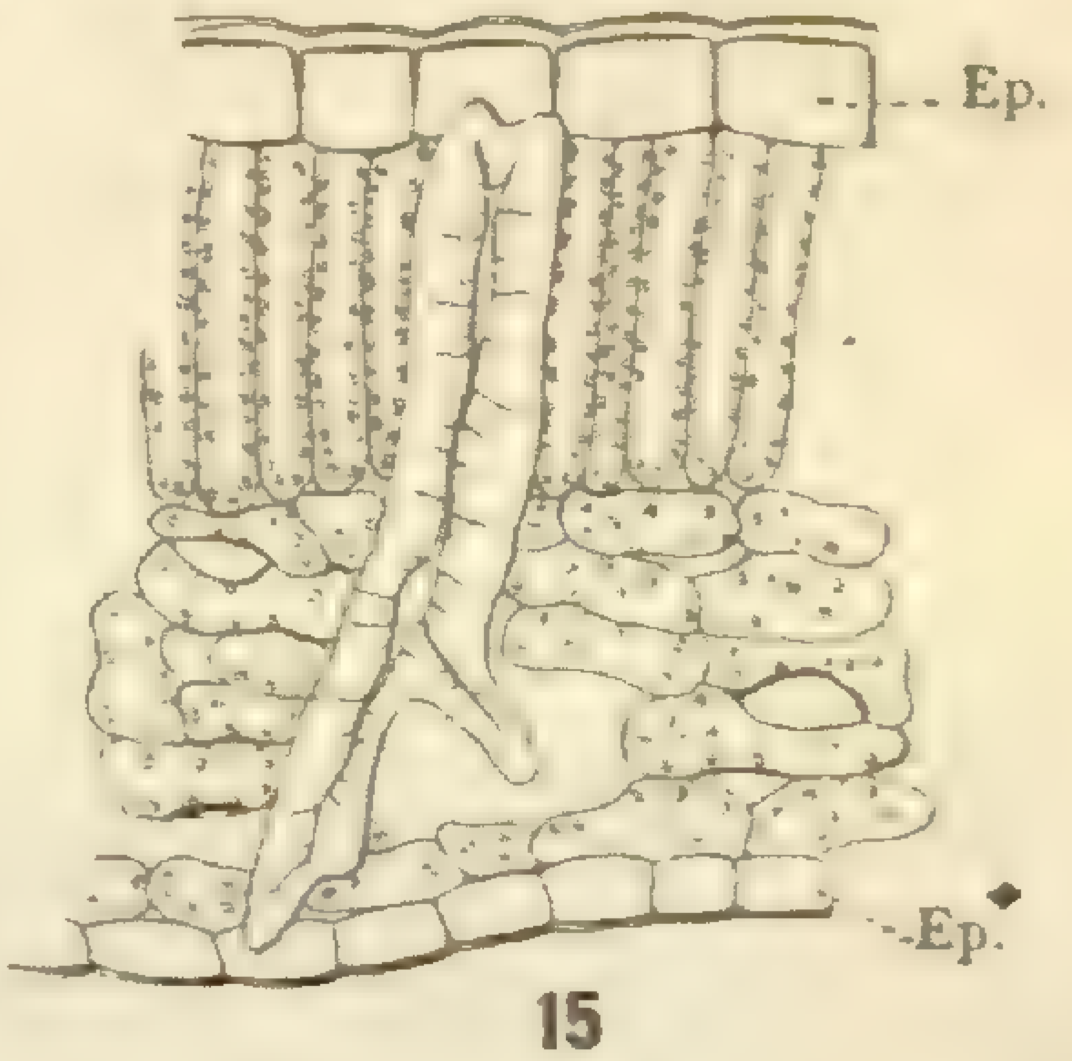

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PLATE X. HOLM on NYSSA SYLVATICA.

somewhat more advanced stage (Fig. 9.) we notice in this parenchyma a beginning development of leptome (L. in fig. 9.) beside tangential divisions, indicating the origin of an interfascicular cambium in direct connection with the primary intrafascicular. It is from the interfascicular cambium that the secondary leptome and hadrome become developed, rapidly increasing in thickness so as to equal the primary. In regard to the other tissues of the hypocotyl we might mention that near the base the cuticle is thin and smooth; covering a small-celled, thinwalled epidermis destitute of hairs. Furthermore that the cortex is homogenous, thinwalled, frequently collapsed, and that the hypodermal stratum shows a formation of cork. There is a distinct endodermis, thinwalled, but readily noticeable by the Casparyan spots, and inside this sheath is a thinwalled pericycle, which in the apical portion of the hypocotyl becomes stereomatic, but as already indicated only outside the primary leptome. Near the cotyledons the epidermis becomes thickwalled with the outer cell-wall extended into minute longitudinal crests, and the cortex is here solid, not collapsed. No crystals of calcium oxalate were observed in any parts of the hypocotyl. A somewhat modified structure occurs in the first internode of the same seedling (Fig. 1.) In this the cortical parenchyma consists of collenchyma near epidermis, while the internal strata are thinwalled and contain large, single crystals of calcium—oxalate, besides some aggregates of the same substance. There is no endodermis, but a pericycle of isolated strands of typical stereome surrounding the stele.

The seedling, thus, illustrates the primary structure and certain parts of the secondary, not only within the stele, but also near the periphery, when the cork has already made its appearance.

If we now examine branches of the mature tree, we meet with a much firmer structure; the cork represents here numerous and very thickwalled strata, covering a cortex which is collenchymatic throughout, and rich in chlorophyll; then follows the pericycle of thickwalled stereome intermixed with large, porous sclereïds, forming a closed sheath around the stele. In this the secondary hadrome contains scalariform vessels, porous tracheids with bordered pits, and much thickwalled libriform; the medullary rays are single with the cells stretched radially and filled with starch. The centre of the stele is occupied by a heterogeneous pith, starch-bearing and active in the periphery, but empty in the centre. A corresponding structure recurs in the peduncle, when the fruit is ripe. However,

the epidermis persists and is very thickwalled. There is no cork, and the cortex is collenchymatic throughout, the pericycle is very strongly developed with heavy layers of stereome and sclereïds, while the stele is narrow, surrounding a thickwalled, starch-bearing pith.

The mechanical tissues, collenchyma and stereome, are thus well represented in the stem of *Nyssa*, the former pertaining to cortex, the latter to the pericycle, or inside the hadrome as libriform. It is, also, of some interest to notice the superficial cork, and the occurrence of calcium oxalate as single or aggregated crystals in the cortical parenchyma.

THE LEAVES.

When cotyledons are aerial and foliaceous* they generally assume the same, or approximately the same structure as the leaves proper. They are mostly glabrous, however, and the chlorenchyma, sometimes, shows a less pronounced differentiation as palisade and pneumatic tissue, beside that the veins are frequently embedded and not projecting on the dorsal face. In speaking of *Nyssa sylvatica* the cotyledons do in some respects, possess a structure, which is rather distinct from that of the mature leaf of the tree, but not so much from that of the primary leaves, which I have drawn in figure 1 (L^1-L^3).

The principal distinction consists in the structure of the epidermis which, on both faces of the blade, exhibits undulate lateral cell-walls (Fig. 10), while in the leaves of the tree, these walls are nearly straight (Fig. 12); another distinction consists in the much larger size of both stomata and epidermal cells in the cotyledons, when compared with the mature leaves; this may be readily seen from the figures (Figs. 10 and 12) which are drawn to the same magnification. There are no hairs, and the leaf-structure is bifacial with a ventral palisade tissue, and a dorsal pneumatic. The midrib contains a single collateral mestome-strand surrounded by a thin-walled, barely stereomatic pericycle and a parenchyma of thinwalled cells destitute of chlorophyll; the secondary and tertiary veins are completely embedded in the chlorenchyma and provided with typical parenchyma-sheaths; no idioblasts and no crystals were observed in these leaves.

The short petiole is, also, somewhat different from that of the

* Merck's Report Dec, 1909.

mature leaves of the tree, since the mestome-strands (about seven) are arranged in a plane instead of in a stele. If we examine the primary leaves (L^1—L^3 in figure 1) we notice exactly the same structure of epidermis as to lumen and shape as described under the cotyledons. These primary leaves, however, are hairy, and the veins show the same simple structure as observed in the cotyledons. No crystals were found and no idioblasts either, although such occur in the petiole of the same shape as in the final leaves.

The foliar structure characteristic of the species is, however, the one possessed by the leaves of the mature tree. These are during the summer held in a horizontal position, and their structure is bifacial with stomata confined to the dorsal face, and with a ventral palisade-tissue. Very distinct cuticular striations are noticeable on both faces of the blade, but only the dorsal is hairy with small glandular (Fig. 14), and very long pointed hairs (Fig. 13), unicellular in both. The stomata (Fig. 12) have, sometimes, subsidiary cells parallel with the stoma, but are much smaller than those of the cotyledons and primary leaves. As already mentioned the lateral cell-walls of epidermis are nearly straight (Fig. 12), and the outer is thinwalled except beneath the midrib. The palisade cells represent a single layer, and are very high (Figs. 15 and 16), covering a few (about six) strata of irregularly branched cells constituting a pneumatic tissue with very wide intercellular spaces, which are especially noticeable in superficial sections (Fig. 11). We find in the chlorenchyma numerous idioblasts (Fig. 15), very thickwalled and porous representing the so-called sclereïds. These peculiar cells are known, furthermore, from species of *Garrya* and *Griselinia*, and they show translucent dots when the leaf is held towards the light. The midrib has a dorsal keel with hypodermal collenchyma and a large tissue of thinwalled, colorless parenchyma, but lacks endodermis; there is, on the other hand, a thickwalled stereomatic pericycle covering the leptome-side of the two separate mestome-strands which constitute the midrib. These two strands turn their leptome towards the surface of the blade, thus the hadrome is in the centre enclosing a small pith. Of these the dorsal strand is the larger; it is crescent-shaped (in cross-section) and contains leptome, cambium and relatively long rays of vessels. All the other veins are provided with distinct parenchyma-sheaths (P. S. in fig. 16) and are connected with both epidermes by strata of thin-walled parenchyma; they are frequently supported

by a little stereome on the hadrome-side. No crystals were observed in the blade of any of these leaves.

In regard to the petiole which often exhibits a structure characteristic of certain species, when examined just beneath the leaf-blade, we find in our *Nyssa* a large stele composed of six mestome-strands of the same structure as those in the midrib. A cross-section of the petiole shows a hemicylindric outline; epidermis is hairy and very thickwalled with wrinkled cuticle on the vertical face, and there are several, about six, hypodermal layers of thick-walled parenchyma with the stele. In this parenchyma large single and aggregated, globose crystals of calcium oxalate are quite abundant, beside some few idioblasts, very conspicuous by their enormous size and stellate shape. There is no endodermis, but a stereomatic pericycle on the leptome-side of all the mestome-strands. The selereïds, the peculiar, small glandular hairs and the mestome-strands being connected with epidermis, these characters together may be of taxonomic importance. In *Cornus florida* for instance * there are no glandular hairs, only long, bifurcate, and no sclereïds; furthermore the lateral veins are embedded in the chlorenchyma. But otherwise so far as concerns the internal structure the *Cornaceæ* offer no well marked characters by which we might distinguish the genera or the species; on the other hand we must admit that our knowledge of this particular part of the structure is, at present rather limited, not speaking of the root-system and the seedling-stage with the primary leaves. To the diagnosis of the species *N. sytvatica* should be added that the leaves of young specimens are frequently dentate like those of *N. aquatica* Marsh.

Fig. 1. Seedling of *Nyssa sylvatica* Marsh. R, the primary root; H, the hypocotyl; Cot., the two cotyledons; L^1, L^2 and L^3, the primary leaves; natural size.

Fig. 2. One of the cotyledons, showing the venation; natural size.

Fig. 3. Leaves of a shoot from a shrub; two thirds of the natural size.

Fig. 7. Leaf from a shrub, showing the dentate margin; two-thirds of the natural size.

Fig. 8. Cross section of hypocotyl; C, cortex; End., endodermis;x496.

Fig. 9. Cross section of hypocotyl; Camb, cambium; L., leptome; the other letters as above; x496.

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* Aerial, nonfoliaceous cotyledons exist, but are evidently very rare; they occur in Jatropha (Bot. Gazette 1899 p. 60).

Fig. 10. Dorsal epidermis with stomata of cotyledon;x320.

Fig. 11. Pneumatic tissue of same; x320.

Fig. 12. Dorsal epidermis with stomata of a leaf from a tree;x320.

Fig. 13. Base of a long, unicellular, pointed hair of same;x320.

Fig. 14. Glandular hair of same;x320.

Fig. 15. Cross-section of leaf from a tree, showing a large idioblast in the chlorenchyma; Ep.,* ventral, Ep., dorsal epidermis; x320.

Fig. 16. Cross-section of same leaf, showing a lateral vein with colorless parenchyma, stereome, and parenchyma-sheath, [P. S.); P, palisade tissue; the other letters as above; x320.

Brookland, D. C.

Book Notices.

A NEW HISTORY OF BOTANY

There is not yet extant in the English language any work, or even the beginnings of any work, that is of the nature of a history of botany from the earliest times down to the present. For such history of botany in general as we have we are indebted to the zeal and learning of Frenchmen and Germans of the eighteenth century and the early nineteenth; and these attempts are partly in French, partly in German, and the best of them are in Latin.

There is now in the press in this country, and under the auspices of the Smithsonian Institution at Washington, the first volume of a work in English bearing the title of *Landmarks of Botanical History;* an enterprise undertaken by Doctor Edward L. Greene, an Honorary Associate of the Institution.

The plan of this forthcoming work, as the title implies, is that of a careful study and plain elucidation of principal epochs in the development of the science from the earliest period. Such treatment of a subject as ancient as botany, having a literature so vast, and having undergone so many vicissitudes of advance and retrogression during more than two milleniums, can not by any possibility be reduced to the limits of a single volume, but must fill two or three at the least; and that which it is promised we soon shall see is but a first instalment, and not a very large one, of the *Landmarks;* but as replete with a great number, and much diversity of facts never before presented in any history of botany, that it fills

not much more than 300 pages will not, after due consideration, be thought a small instalment.

The more strictly historical chapters, of which there are eight or nine, are preceded by some 40 pages of an Introductory entitled Philosophy of Botanical History; a dissertation on how a history of botany ought to be written; enquiry as to several different lines along which progress ought to take place and should be recorded. Here the somewhat too restricted views of certain earlier historians are adverted to; restrictions due to less comprehensive notions as to what botany really is. Also in this Introductory it is shown that botany, even scientific botany, is so very ancient that its earliest beginnings are traceable to no book, but antedate all writing; that no plant name in any language is the name of an individual plant; that every such name unmistakably implies botanical classification; that these common terms in the speech of every people, plant names, are every one either generic, specific or varietal, not excluding family names, which also occur in the oldest known books that deal with plants. Thus, it is shown, is systematic botany of some kind among the very essentials of human speech and writing, whensoever plants are to be considered. This, apparently the true philosophy of the origin of the science, and of its history, seems to be Doctor Greene's own.

Directly following a short chapter on earliest traces of philosophic botany in very ancient Greek writing, there is a long one on Theophrastus of Eresus, whom the most competent botanical scholars, up to less than a hundred years ago agreed in styling the Father of Botany as a science; whom also our later generations have known nothing of. To the readers of Doctor Greene's *Landmarks* it will appear as if the fundamentals of even modern botany had been settled, set forth in public lectures at ancient Athens, and written into a book by this philosopher two and twenty centuries ago.

The chapter on Theophrastus occupies 90 pages, and is the largest one in the volume. The leading paragraphs of the chapter are in the following succession, and the eye is guided to each by special type: **Life, Method** (in general), **Vegetative Organography, Anthology, Fruit and Seed, Anatomy, Phytography, Taxonomy, Nomenclature, Ecology, Dendrology, Transmutation** (of species, and even genera).

As a contribution to the written history of our science all this matter is new, and will be apt to prove instructive reading to most

of us; for we have been taught, often enough by definite precept, and always and everywhere by implication, that scientific botany had no being until 150, or at farthest 200 years ago.

After the time of Theophrastus the most notable epoch in the advance of botany was that inaugurated in the first half of the sixteenth century; a movement in which certain German professors and physicians had a conspicuous part. These are Brunfels, who lived between 1464 and 1534, Fuchs, 1501–1566, Tragus, 1498–1554, and Valerius Cordus 1515–1544. The German historians of botany, three or four of them, have designated this quartette of celebrities the German Fathers of Botany. This title is conceded them, though with some reluctance by the author of the new *Landmarks;* or, if not exactly with reluctance, at least with some discernment; for the four celebrities, by the careful analysis of the work of each, are seen to fall into two rather distinct categories, so that to Brunfels and Fuchs there is accorded the title of German Fathers of plant Iconography only, while Tragus and Cordus only are accredited as German Fathers of Botany. It is a piece of discrimination that is new; and it amounts to a judgment of the comparative merits of the four which is quite opposite of that to which German historians themselves had arrived; for these almost with one accord make of Brunfels and Fuchs the greatest promoters of botany, holding Tragus and Cordus in less esteem. But in truth, Brunfels and Fuchs did little more than employ excellent artists to draw and picture plants, then proceeded to edit the engravings, accompanied by rather imperfect descriptions borrowed from the ancient Greeks and Romans. But by virtue of the engravings representing some hundreds of plants with a faithfulness to nature which was a new thing in the world, the two folios, that of Brunfels in 1532 and Fuchs in 1542, were immediately successful, immensely fostering a new interest in plants, and this not so much, it may be, among the learned, as among the common people and the illiterate; for not even the rudiments of an education are requisite for the identification of an herb or tree if comparison can be made with a good figure, and there is no need of becoming able to read and understand the description. The two were great popularizers of plant knowledge, at the time; their folios were financially successful; matters which, after all, do not necessarily make very much for the advancement of botany as a science.

Quite the opposite of this were the minds and the works of

Tragus and Valerius Cordus, it would seem; for these are said to have pursued the gathering and studying of plants for the love of plants; and that when each began to think of writing a book, the purpose in either case was, not to employ draftsmen and engravers, but so carefully and faithfully to describe each plant from nature that, to all who could read, the species might be identified by description alone. The folio of Tragus was published first in German, and made so strong an impression by virtue of the life-like picturing of plants by words, as well as by a vast amount of new information conveyed, that the learned botanical world seemed to demand all this in Latin, then still the language of the educated everywhere; and such an edition was given, and even illustrated by many wood cuts, largely copied in smaller size from Fuchs. Valerius Cordus was the last of the four German Fathers, and is usually treated by even German historians as the least among them. Sachs even passes him by with a remark that he was of no importance. Nevertheless, in the judgment of the author of the *Landmarks*, he was by far the ablest and most accomplished of them all, as well as the one who most advanced philosophic and real botany. His description of plants,—both ancient and classic plants, as well as new German species by the score or hundred—are now everywhere seen to far surpass those of any and all of his predecessors. The author of this volume of history reports that Cordus was the first of botanical investigators to note the mode of the enfoldment of any leaves in the bud, and of petals in flower buds; the first to distinguish anther-dust and call it pollen; first to affirm that ferns propagate by the dust on the back of leaves, and to state that this generative dust is not of the same structure as seed. All this, too, long before the invention of the microscope, hand lens, or spectacles. He is accredited as the actual first discover of such familiar types as *Caltha palustris* and *Parnassia palustris* and the cranberry vine, to which also he gave the generic name *Oxycoccus*, which it still is known by. Even the snowball bush, *Viburnum Opulus* variety, which was first seen by Cordus in a German mountain wilderness, and was named by him as a mere variety of the bush called upland cranberry. He was first to describe the sundew, and to publish a report on the nature of the so-called dew on its leaves. The term papilionaceous we appear to owe to Cordus, who is shown to have invented it—to have used it often, and even to have determined as true leguminous plants, certain

small flowered ones whose fruits were not legumes strictly speaking. Being geologist and mineralogist, he is first among botanists to mention, in his ecologies of certain plants, the geologic formation, or at least the probable constituents of the soil in which they grow.

Throughout the volume, the work of each maker of a botanical landmark is analyzed, and the particular lines along which each wrought most are, as we have indicated above, made subjects of special paragraphs, each paragraph showing its caption in prominent type. The first of these paragraphs is always that of the Life of the botanist. These biographic sketches are more full by far than is usual in such history, and will doubtless be read with interest by all botanists, if not even by the unbotanical.

The work will shortly appear, and will form a part of Volume 54 of the Smithsonian Miscellaneous Collections

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Editorial Notes.

CHANGES IN PLANT NAMES.

It may be seriously questioned whether in ruling that plant names must begin with the date of Linnaeus' Species Plantarum of 1753, more confusion has resulted than had ever been anticipated. More changes in nomenclature have been made since botanical congresses have convened than before it was deemed necessary to legislate in this matter. Every time a congress meets we are sure that as the result of its artificial decisions a number of well established names will go. The Vienna Congress decided that "nomenclature should not be arbitrary nor imposed by authority" (Art. 3) but based on priority. (Sect. 1, Art. 15) Apart from the fact that one of the first rules (Art. 19) absolutely precludes the idea of priority there can be no more arbitrary decision possible than the statement of Article 20.

"*However, to avoid disadvantageous changes in the nomenclature of genera* by the strict application of the rules of Nomenclature and especially of the principle of priority in starting from 1753 the rules provide a list of names which must be retained in all cases. These names are by preference those which have come into general use in the fifty years following their publication, or which have been

used in monographs and important floristic works up to 1890. The list of these names forms an appendix to the rules of Nomenclature."

The obvious reason for this arbitrary and sweeping exception to the law of priority since 1753 "*is to avoid changes in nomenclature.*" Has this been affected? As the rule may be and actually has been interpreted any change may still be made of a plant name which according to the rule is not in the list though it may have been in use up to 1890 for fifty years. In Gray's Manual, seventh edition, we find several such changes, and changes of names that had been up to the present time in use, *for not only fifty years but actually, in one case, for one hundred and fifty years!* Such changes are moreover, made by those who claim that they have "*scrupulously* endeavored to bring the nomenclature of the manual in accord with the Vienna agreement in order that American nomenclature may be freed as speedily as possible from peculiarity or provincialism, and assume the form which has received international sanction."*

Limnanthemum was applied as a name of a segregate genus from the Linnaean *Menyanthes* by Gmelin in 1769, and there has been no other name used for it as a separate genus, up to 1908, the year of the seventh edition of Gray's Manual. It was found, however, the *Limnanthemum* had not priority and a name completely forgotten, *Nymphoides*, Hill 1756 substituted. As the name has priority no one could object to it except for etymological reasons which Linnaeus † gave more than a century and a half ago.

Whatever the reason there be for changing *Ulmaria* to *Filipendula*, the latter is new and the former has been used for more than a hundred years. Added to this *Ulmaria* is as a matter of fact as old as *Filipendula* even since 1753, both having been published by Hill; in 1756.‡

The best reason why *Nymphoides* can be used for *Limnanthemum* according to the rules is that it is not on the list of condemned names, though we feel sure that had that eminent assembly thought of the name it would certainly have been put on the list. The only way to do away with it according to international rules is for botanists to assemble again and condemn it.

I do not wish to cast a slur either on congresses which are not

* Gray's Manual, 7th edition, 1908, Preface, p. 7.

† Hill, J. British Herbal. 1756.

‡ Linnaeus, C. Historia Botanica, 1751-1754.

supposed to be omniscient nor on editors who "scrupuously follow their rules," but the moral of the present discussion is that botanical congresses no matter how often they meet and how many rules they make, will never do what they set out to do; namely, "avoid disadvantageous changes in nomenclature."

On the whole we are inclined to think, after carefully studying the history of these changes, that fewer would be made by going back to the only fundamental reasonable principle of nomenclature, namely; *absolute historical* priority, not limited to 1753, but going back as far as we have any certain indisputable proof of the identity of plant names. The "starting point" 1753 in nomenclature, has been made to avoid confusion of names of genera, but results so far have not been forthcoming and it is safe to say that no more radical changes of names could or would result if we disregard entirely the artificial and unreasonable "starting point," 1753, as it is evident from such works as S. F. Gray's, 1821, E. L. Greene's, Flora Franciscana, and Bay Region Botany, or Bubani's Flora Pyrenaea, or Tidestrom's Elysium Marianum the principle of whose nomenclature goes back to even Theophrastus, Dionscorides, Galen, Pliny, Varro, Vergil, Dodonaeus, Lobelius and Brunfels for valid names of genera.

THE CODE OF THE NEAR FUTURE.

We have some very strong reasons to believe that it will be only the matter of a few years when botanists will come to see the futility of the contradictory codes in question of nomenclature. The Vienna Code was not expected to satisfy everybody by its arbitrary decrees, well meant though they be. American botanists especially are not satisfied, and already amendments have been proposed. Best of all we feel that it is becoming more apparent daily 'that the codes are not only not doing what the set out to do,—bring about uniformity, but they are actually "making confusion worse confounded." American botanists are pondering this matter deeply at present, and very little is being said in public. Every one that does consider the matter philosophically realizes that the codes must eventually come to the *principle of absolute historical priority* in matters of *biological nomenclature*. All artificial "starting points" of dates before which no names are to be taken, are coming to be looked upon as illogical. The leaven of truth is slowly fermenting in minds that are responsible for the science of the times, and it will not be very long before results show. It is to be questioned whether the actual changes of names necessary to be made to bring absolute historical priority of names into effect, would be many more than the exceptions to

article 20 of the Vienna Code. Linnaeus, almost as a rule, chose the names of the older botanists before him, and the number of changes would be comparatively insignificant, especially in our American flora. This fact is only too evident from consulting the works of Dr. E. L. Greene, *Flora Franciscana* and *Bay Region Botany*.

Serious minds are beginning to realize also that if we must eventually come to the principle of unrestricted priority in time, it might as well come soon. Already there are proposals for artificial "starting points" for the other different branches of systematic botany, so that one date is proposed for Mycology, another for Algology, and if we follow the illogical suggestions we must have as many "starting points" as there are divisions of systematic botany. A generation and more has Dr. E. L. Greene stood up for the principles of absolute historical priority and we have good reason to think at present that he will yet see this the prevailing sentiment in public as it is tending to become so in private. More than two decades did Pietro Bubani spend on that colossal work of his, so little known, yet withal so erudite, in spite of a number of eccentric inconsistencies, his *Flora Pyrenaea;* whose principle is that of historic time priority, and even then it was published after the author's death. The way to the truth then is already broken through the dark forest of error, but we must await some bold genius that dares follow the trail. We could name not a few, if we would, great botanists too, whose ideas on this question are correct, whose private opinions are more logical than their public expressions, and accordingly we know that the day is not far distant, when codes will be discarded and the only guide will be the principle of absolute and certain historical priority in nomenclature.

News Notes.

Prof F. L. Charles, of the University of Illinois, is to be the new secretary and editor of the *American Nature Study Review*. The Society through this, its official organ of publication proposes giving considerable attention in the future to the question of agricultural teaching in elementary schools.

Mr. Ivar Tidestrom, of the U. S. Department of Agriculture, has been engaged during the past summer in making extensive journeys studying the flora of Utah, Idaho and Montana. Special investigation has been made of the flora of Utah for some years by him, and we hope his work will eventually culminate in a manual of botany of that state. He has also been doing research work on the noxious and poisonous plants of that region.

Dr. J. A. Nieuwland, Professor of Botany in the University of Notre Dame, spent the Summer in the study of the flora of the Willamette Valley in Oregon, making collections of plants in that country. Summer school work was also done at Columbia University, Portland, Ore.

Dr. Edw. L. Greene, Honorary Associate of the Smithsonian Institution, made, during the Spring, a botanical tour of several weeks through Indiana, Illinois, southern Michigan and Ontario. He made a special investigation of the violets and antennarias, also a general ecological study of the country. Many problems regarding the habitat of his new species, already published, from this region were cleared up.

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An Analytic Study of Faunal Changes in Indiana.

WALTER L. HAHN.

It is a matter of common knowledge that the fauna and flora of the Central States have changed greatly during the last century. The changes in Indiana have been referred to incidentally or discussed at some length in various places.* An extensive analysis of them has not been published heretofore.

The greatest obstacle to such an analysis is the lack of positive information as to the former abundance of most species. From local histories, tales of exploration, reminiscences of "oldest inhabitants," and the like we can obtain a fairly accurate picture of the larger species, the game birds and animals and even the larger fishes. But our knowledge of the former abundance of the native mice, the chipmunks, the less conspicuous birds, the smaller fishes, and more particularly of the mollusks, crustaceans, insects and other small creatures, is necessarily very limited. In some instances, deductions can be drawn from the position the species occupies in the general scheme of nature.

It is the purpose of this article to collate and discuss the data that are available on the subject. The facts to be considered may be grouped under the following heads:

1. The extermination of the bison at about the time white settlers became numerous.

2. The extermination of the beaver, couguar and wapiti not long after the disappearance of the bison.

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* Butler, Bulletin Brookville Soc. Natural History, No. 1, 1885. pp. 5-13. Proc. Ind. Academy of Science, 1895, pp. 31-42. Culbertson, Proc. Ind. Academy Science, 1908, pp. 27-37. Hahn, 33rd Ann. Rep't. Dep't. Geology and Nat. Resources of Indiana, pp. 418-663.

† February 15, 1910.—Pages 145 to 164.

3. The final extermination of the deer long after its relative, the wapiti, had become extinct.

4. The extermination, partial or complete, of nearly all of the Carnivora.

5. The ability of the red fox and coyote to maintain their existence where other species, related to them, and with similar habits, have been extirpated.

6. The differential reduction in number of the larger rodents, the porcupine being extinct, and the gray squirrel having suffered more from advancing civilization than the fox squirrel.

7. The probable increase of many small rodents.

8. The practical or complete extermination of the pileated and ivory-billed woodpeckers, paroquet, passenger pigeon, prairie chicken, wild turkey and ruffed grouse.

9. The marked decrease in number of waterfowl.

10. The notable increase in number and extension of the range of many passerine birds.

11. A marked decrease in number of many fishes, mollusks and other aquatic animals.

12. An increase in number of certain insects, accompanied by an extension of their range.

13. A decrease in number of a few species of insects.

We will now consider, with as much detail as space allows, the factors that render some species more fit than others in the struggle for existence under the conditions that have existed in this State during approximately a century and a quarter — namely the manrelation.

MAMMALS.

THE BISON.

The facts concerning the extermination of the bison are too well known to require a lengthy discussion. Hornaday* ('89) recognized two periods of extermination, that of desultory destruction, from 1730 to 1830, and the period of systematic destruction, from 1830 to 1888. The first period embraces the disappearance of the species from all of the territory east of the Mississippi. According to Hornaday, during the first period it was killed by the settlers principally for food; during the second it was wantonly butchered for hides and tongues.

However, it is the purpose of the present paper to ask

* The Extermination of the American Bison, W. T. Hornaday, Report of the U. S. National Museum for 1887, pp. 369-548. See also 33rd Ann. Report Indiana Dep't. of Geology and Natural Resources, pp. 425 and 452.

the reason, from a biological standpoint, for the early disappearance of the race. The reasons are several in number and it is not possible to say that any one is of much greater importance than the others. To quote again from Hornaday, "His dullness of intellect was one of the most important factors in his extermination." This dullness of intellect manifested itself chiefly in a stupid disregard for danger: the animals instead of trying to escape often stood quietly watching the death struggles of their companions who fell before the rifle of the still hunter.

Such stupidity would not be possible in a wild species that was not very perfectly adapted to its surroundings by sufficient size and strength to render it immune to attacks by enemies. Large size, which was advantageous in enabling the animals to overcome their brute enemies, only served to make them more desirable game for man, without protecting them in the least. The habit of association in large herds, also protective under primeval conditions, served to hasten their extermination when man came upon the scene.

We must also take into account the fact that the high specialization of the bison had probably brought it to the zenith of its development as a species. The family *Bovidae*, to which it belongs, is apparently a decadent one, decadent primarily because it is not adapted to the manrelation. The various antelope of Africa, now so rapidly disappearing, are members of this family as are the decadent bison of Europe and the aurochs which was exterminated during mediaeval times. In historic times the American bison has been without near relatives on this continent, although fossil bisons are found in strata of comparatively recent geological periods. It is not possible to say whether these facts have any importance bearing upon the extermination of the species, but the rise and fall of species, genera and larger groups during past ages seems to have a biological as well as a geological significance.

THE BEAVER.

The beaver although much smaller in size, was exterminated shortly after the bison. The commercial value of its fur excited the greed of trappers and early settlers and led them to hunt it almost as vigorously as the bison. Like that animal, the beaver was very gregarious, and was therefore more easily trapped or shot. Had it been more prolific, like the muskrat, or more wary, like the mink, it would have escaped extermination much longer, but it also was highly specialized for a particular mode of life wherein it had been comparatively secure.

WAPITI AND DEER.

Wapiti and deer belong to the same family but to different genera. The former species is much larger than the latter and was never as numerous. Both species thrive on the coarsest kinds of food, dead leaves, twigs, weeds, and other coarse plants being both nutritious and palatable for them. Therefore their extermination was not due to lack of food.

Wapiti, or elk as it is frequently, although incorrectly, called, had become scarce in this State previous to 1810 and became extinct about 1830. Deer were not uncommon in many localities in 1850 and did not become extinct till 1893.

What enabled deer to survive sixty years longer than wapiti with a rapid increase in population? In a general way their habits are similar, their food is not essentially different and they occupied the same territory.

According to Roosevelt ('02) "Wapiti are the most gregarious of the deer family." During the mating season, which is in September, they congregate in large herds. They are highly polygamous and the males fight violently for the females and become very noisy.

Deer sometimes band together but do not gather into large and compact herds under the leadership of a single old buck as do wapiti, nor do they become as noisy. In a region where they are much hunted, they hide away during the daytime in dense thickets or inaccessible swamps. They are more prolific than wapiti, begining to breed at an earlier age and frequently producing two young at a time.

Deer are timid, fleet and wary. Wapiti are usually shy, but loose all their wariness at mating time; even at other times they may exhibit surprising stupidity and make no attempt to escape from danger.

In short, deer survived longer than wapiti because they are smaller, more timid, less gregarious and more prolific. The permanent survival of wapiti in the wild condition in such a region as this State affords was out of the question. If any remained at the present time, they would be an intolerable nuisance. Deer might have been preserved in rugged or marshy localities, as they are in many of the eastern states, had they been given adequate protection. Clearing away the forests, draining swamps and placing the land under cultivation left them without hiding places and they became easy prey for hunters.
quarter — namely the man-relation.

THE LARGER CARNIVORA.

The first of the Carnivora to disappear was the couguar.

In contrast to the preceeding species, it furnished no products of much value to man. But it caused the early settlers to fear for their lives and it also destroyed their domestic animals. Consequently it was eagerly hunted. Like the bison, it had been immune fom danger because of its size and strength, and therefore was not prolific. The encroachment of civilization increased the death rate by a large percentage and resulted in the rapid disappearance of the species.

Bears became rare about 1840 but not extinct before 1878. They are to be classed as game animals, for not only was their flesh highly prized, but the killing of a bear was always considered quite a feat of sportsmanship. They were thought to be dangerous to human life, although there are few instances on record of an unprovoked attack upon a human being. They did some damage, however, by carrying off pigs and occasionally other domestic animals. For these reasons a bear hunt always followed the appearance of one of the animals in any community, and they owed their long survival to the fact that after the country became thickly settled, they retreated to the swamps where they remained in hiding most of the time.

The Canada lynx and the smaller bay lynx are so hopelessly confused in the zoological literature of the State that it is not possible to distinguish their records. Both were commonly called "catamount" or "wild cat." The first of these species has undoubtedly been extinct for a number of years. The second has not been common for half a century but was killed within the State as recently as 1906 (Hahn '09a), and may yet exist in the less accessible swamps. The cause of their extermination, like that of the other Carnivora, was chiefly their depredations upon domestic animals and the fear in which they were generally held. The Canada lynx is a dweller of the great forest and those individuals that were not killed outright doubtless retired voluntarily before oncoming civilization. The bay lynx has been able to survive because it has, to a large extent, abandoned its predatory habits and retreated to the swamps where it remains in hiding most of the time, subsisting on the wild life about it.

The gray or timber wolf was very abundant when the State was first settled but has been comparatively rare for five or six decades although it has been killed in Knox County as recently as 1908 (Hahn '09a). The early reduction of the species was due to its destructive habits, and the survival of a few representatives to the fact that they learned to "lay low."

The coyote was also numerous at one time, then became very rare, and during the last ten or twelve years has again increased to such an extent that it bids fair to overrun the

entire State and become a serious pest. It has been able to learn by experience to such a degree as to become adapted to the man relation. In so far as we are able to judge, this adaption has been almost wholly of a mental character. The coyote is intelligent and teachable and has solved for itself the problems that it had to face. In this it is like its relative, the red fox. Just what change has taken place in the coyote's habits, I am unable to say. The animals still hunt in packs and they still molest poultry and other small domestic animals. But they seem to have learned to avoid traps and poison and to spend most of their time at a distance from human habitations.

The red fox was referred to above as an example of a species that has become adapted to the manrelation, but the gray fox differing very little from the red in size and habits, has been gradually decreasing in all parts of the State. The two species are not very closely related in spite of their external resemblance. The gray species is unquestionably a native of the region, while the red is not, and may even be an importation from Europe. If the latter supposition is the true one, the species has been gradually acquiring the ability to live in close proximity to man during his progress from savagery to civilization, instead of having to acquire it in a few generations after man had already learned the use of guns and traps.

THE SMALLER CARNIVORA.

Under this head we may include the raccoon and all of the members of the family *Mustellidae*, although some of the latter are nearly equal in size to the foxes.

The raccoon is not of very great economic importance although it commits some depredations on poultry and its skin has some commercial value. It is a forest dweller and its natural habitat has been largely destroyed, but it is adaptable and in some places has taken up its residence in drains and ditches. Nevertheless it has been decimated during the past century. This is due, in part, to the curiosity of the animal which leads it to explore every fallen log and investigate every unusual object and thereby makes it easily trapped. The clumsiness of the raccoon makes it unable to escape pursuit in any way except by climbing, and made it easier to capture and kill, and thereby making 'coon hunting a popular sport.

Otters are semi-aquatic animals possessing a furry coat of much value. These two facts account for the almost complete extermination of otters in our State. They frequent water courses, and have regular pathways along the banks,

and slides going down to the water and consequently are easy to trap.

The mink is a relative of the otter but is less aquatic and its hide has less value. On the other hand, it often raids poultry yards and so incurs greater danger. It is swift of foot, cunning and resourceful, although not especially shrewd in avoiding traps. Its cunning and its ability to hide enable it to still exist, though in greatly diminished numbers. The weasels are but smaller editions of the mink and are able to hold their own better because of the lesser value of their fur and their inconspicuous size.

THE RODENTS.

Aside from the beaver, the most interesting of these is the porcupine. It is almost unique in having no economic importance whatever, being in no wise destructive and having practically no use. Destruction of the forests which it inhabited may account, in part, for its disappearance. But its extermination was due principally to the spiny armor that it wore. This coat had rendered it practically immune from danger from other animals and its birth rate was consequently low. In addition to this, it was sluggish in disposition and indifferent to danger. But one of the most important factors in its extermination was probably the extraordinary appearance which the long spines gave to the animal. These made it conspicuous and led men to kill it merely from curiosity, as they kill any strange creature that attracts their attention.

Tree squirrels were comparatively safe from beasts of prey because of their arboreal habits. They were very abundant when the State was first settled and have since been more than decimated. The first considerable destruction was due to the efforts of the pioneers to protect their crops against the ravages of the innumerable hordes of squirrels. Later, deforestation aided in their reduction, and hunting for sport and food has continued the slaughter.

There is unquestionable evidence (Hahn '09a) that the gray squirrel was the more numerous species when the State was first settled. At the present time fox squirrels are fairly common in most of the groves of trees remaining about the farms. The gray squirrel, on the other hand, is rare outside of the most extensive of the remaining tracts of timber. I am unable to suggest any reason for the change in relative numbers of the two species. The fox squirrel seems to be better adapted to the manrelation, perhaps because of certain neutral qualities that enable it to escape danger more readily, perhaps because of greater hardiness or some other characteristics that have escaped our notice. It may be noted in passing

that the eastern fox squirrel, subspecifically different from ours, has been nearly exterminated where the gray squirrel still thrives.

Chipmunks and other ground-squirrels, woodchucks, rabbits, muskrats, moles and mice are all comparatively weak creatures and were successfully hunted by many enemies of the primeval forest and trackless prairie. Most of these beasts and birds of prey have been either exterminated or greatly decreased in number, and persecution of the weaker species from at least one source has been lessened. None of the latter endanger the life of man and although they destroy his grain, they do so, little by little, and therefore his desire to destroy them is usually at low ebb. They are too small to be of any value dead and too insignificant to be hunted for sport. Those species that live preferably in grassy places have as large a range now as formerly, for roadsides, pastures overgrown with bushes and similar situations take the place of the former extensive woodlands.

Therefore we may safely assume that this group of animals, on the whole, has increased although little mention is made of them in accounts of the early settlement of the State and we have no means of comparing past and present numbers.

One species included under this head should have especial mention. The muskrat is trapped and hunted for its fur just as the beaver, mink, otter and others have been. It has diminished in number as a result of this persecution, but not as much as the other species, the reason being that it has always had, and is adapted to a high death rate. Man has added to the slaughter inflicted upon the muskrat by wolves, foxes, otters, minks, weasels and other animals, but at the same time he has been the cause of a diminution of the slaughter from these sources.

BIRDS.

Birds occupy a peculiar place in our regard, being universally beloved because of the beauty of plumage, grace of motion or melody of song. Added to these aesthetic qualities we have the usefulness of birds in destroying insects, although in this they are equalled by the despised frogs and other batrachians.

Birds have therefore been protected to an unusual degree in spite of the greed of plume and wing hunters. Yet several species have nearly or wholly disappeared and many others are decimated.

Probably the ivory-billed woodpecker was the first species

to disappear. Data concerning its occurrence in this State are very meager. Wied mentions all of the other woodpeckers of this region in his New Harmony list of 1832-33, but omits the ivory-billed. It was probably about extinct at that time. It was the largest of all our woodpeckers as well as the most handsome and was no doubt wantonly killed because it afforded a conspicuous target for the pioneer riflemen. Like the bison, it was doubtless without formidable enemies and highly specialized for a particular environment, hence when this environment, the vast uninhabited forest, began to disappear the species was unable to stand the stress of conditions. The pileated woodpecker nearly equalled the ivory-billed in size and, like it has almost disappeared.

These two woodpeckers were never very numerous, but the Carolina paroquet and the passenger pigeon were once extremely abundant. The last record of the paroquet in Indiana is in Knox County, in 1859 (Butler '97), although it became rare in most parts of the State twenty years earlier.

The extermination of these birds was due largely to their destructive habits. Both orchards and grain fields suffered from their depredations and they destroyed quantities of fruit and grain in addition to what they ate. They had the habit of gathering in large flocks and sweeping down upon an orchard or a field of ripening wheat and this not only incited the farmers to destroy them but also made destruction the easier.

The passenger pigeon was even more gregarious than the paroquet and also much more numerous. We are told of solid flocks of the flying birds five miles long by one mile wide. Near Petoskey, Michigan, they had a nesting site twenty-eight miles long and three or four miles wide where every tree of the forest contained from one to many nests (Butler '97). Other large flocks, roosts and nesting grounds were common. While the birds probably ate some grain, I know of no evidence that they were especially destructive. But they made good food and had a ready sale and consequently were much hunted. It is estimated that 3,000,000 birds went to market from the Petoskey nesting grounds in 1878, and twice that number perished as the result of wounds and the starvation of nestlings. It is easy to see why the extermination was so rapid under such a system as this, but from the standpoint of the species, the gregarious habit was the fatal adaptation.

The gallinaceous birds were formely represented in this State by four species, the wild turkey, bob-white, ruffed grouse and prairie hen. The first is the largest and is wholly or nearly extinct within our borders; the domestic turkey being descended from another race. The second is the smallest, and, being very prolific, is still found in all parts of the State, al-

though not nearly as abundant as formerly. The other two are intermediate in size and were therefore hunted in preference to the bob-white, and being less prolific, they have become almost extinct, but their shyness has prolonged their existence to the present time.

The ducks, geese, snipe, plover, rails, loons, cranes, herons, etc., constitute a great, heterogenous group of water birds. These were found in enormous numbers about the lakes, swamps and streams before the State was settled. The group as a whole, and probably every species in it, has diminished in numbers, partly because of hunting and partly because their nesting and feeding grounds have been destroyed by draining and clearing the land.

The hawks and owls and other raptorial birds constitute another group having a distinct ecological position. They are compelled to compete with the carnivorous mammals for food and as these have dimished they have gained an advantage. But some of them have preyed on poultry and thereby have aroused man's enmity. As a consequence he has made war upon all species without discriminating between the beneficial and the injurious. The larger species, as the eagles, have greatly diminished in numbers. Some of the prairie species have increased for a time perhaps, but there has been a general, though not uniform, reduction of the Raptores.

The Order Passeres includes all of our songsters, in fact, the vast majority of the smaller and more common birds of field and garden and almost the only species that regularly visit the cities. None are of very large size and none are truly rapacious. Most of them feed wholly on seeds or insects. Hence there is no shortage in food supply, while a decrease in the number of carnivorous mammals and raptorial birds has removed some of their most dangerous enemies.

The species of the group have diverse habits. The warblers, kinglets, vireos and flycatchers are principally woodland birds, but most of the species take kindly to the presence of man and may be seen about groves and orchards, and even in the shade trees that line city streets. Many of the warblers are known to us only as migrants and there is little evidence to show that their numbers have changed. The vireos and warblers that stay with us, nest in open groves and about habitations. Five or six of the flycatchers are shy woodland birds and may have diminished as the forests are cleared.

Crows and jays are reckoned as destructive birds but they are also cunning and well able to care for themselves under most circumstances. They are not especially fond of the forest and I suspect that they may have been on the increase

sixty or seventy years ago but are slowly diminishing at present.

The blackbirds are also destructive and the bronzed grackles have diminished to a marked degree because farmers have shot them to protect crops. The bobolink and red-winged blackbird frequent swamps and marshes and as these have been drained the birds have diminished. On the other hand, the meadow lark is seldom seen far from well drained grass lands. The southern part of the State has changed from heavy forest to pasture and meadow and with the loss of the forests has come an increase of these birds. The orioles love the open woods and orchards and they have probably increased rather than diminished.

The majority of the sparrow family are also grass lovers. The dickcissel first appeared in Franklin County between 1869 and 1879 (Butler '85), and there are records of its first appearance in many other places. The grasshopper sparrow, vesper sparrow, lark sparrow, field sparrow and others must certainly have had the same history, as their habits make it impossible to believe that they were inhabitants of the greater part of southern Indiana a century ago, although now abundant in that region. The most recent intrusion of the prairie avifauna is the Harris sparrow, a species abundant on the plains west of the Mississippi, but first taken in this State at Sheridan on May 4, 1907 (Butler, '08),

The grosbeaks, also members of the sparrow family, are frequenters of the wood rather than the meadow and are probably diminishing. At least that is the writer's personal observation with regard to the cardinal in southeastern Indiana. The same may be true of some other finches, as the fox sparrow and white-throated and white-crowned sparrows, but they are only migrants and the abundance would not be affected by changes of conditions in this State.

The grass-inhabiting sparrows have extended their range eastward, and in this State probably southward. The mocking bird has extended its range northward. The writer is uncertain whether this bird occurred about his former home in southern Indiana during the period ending with 1900, but he is under the impression that it was a rare summer resident. It certainly was not common. During the past six or eight years it has become very abundant. (Hahn, '09b.)

Mocking birds have also become more abundant at Bloomington and have been noted at many localities in the southern third of the State. The species has been an accidental visitor in all parts of the State and evidently is now occupying much of its former accidental range because conditions have changed in some way that has reduced the struggle for existence. The

destruction of forests and diminution of enemies are probably the principal elements in this change.

There is not space to discuss further changes in the bird fauna, even by families, but it may be pointed out that the house, Bewick's and Carolina wrens and bluebirds are other species that have increased in numbers with the settlement of the region. Their preference for the vicinity of man is doubtless a recent acquirement and the result of better protection.

To sum up the changes in the avifauna, the larger species, the more specialized species, the species that are real or supposed enemies of man's welfare, the species that are desirable game, the species that frequent marshes and the species that dwell in the deep woods have all suffered with the populating of the State. The species that frequent human habitations, those that are weak and not destructive in habit, and more especially those that are inhabitants of the drier meadows, pastures and orchards have increased in numbers and have extended their range and are still extending it.

I am of the opinion* that there are as many species nesting and resident in the State now as when Audubon and Wilson visited the region nearly a century ago. I doubt that the individuals are less numerous. They are certainly smaller in size, on the average, and most of the more peculiar types have diminished or disappeared.

(To be continued.)

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*This is contrary to views often expressed. For a confirmatory opinion relating to Chester County, Pennsylvania, see Sharples, Bird Lore, 1909, pp. 263-264.

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The Plateau du Coteau du Missouri.

J. Lunell.

When reading Doctor Greene's paper on North Dakota *Thalictra* I noted with satisfaction that introduction to the subject which took the form of an account of the particular topography of our region, and admired it all the more because I know that the writer had never visited this part of North Dakota, and did not doubt that he had gathered those important geographic data from maps chiefly; and I was gratified by this demonstration of the fact that four different floras meet here on neutral ground, intermingle and mutually impress one another. The present writer, having studied the botany of this territory for more than twenty years, can only confirm the correctness of Dr. Greene's theory.

The elevated barrier, whose real name is The Plateau du Coteau du Missouri, runs in a fairly straight direction from the northwestern corner of the state, where the elevation is about 2500 feet above the sea, to the southeastern end, and is the great divide between the Missouri basin on its western slope, and the basins of the Souris River and the Red River of the North on the east side of it. East of the Souris River the country rises about 500 feet above the prairie, or 2000 feet above the sea, and this elevation, called Turtle Mountains, is 40 miles long and 20 miles wide. No turtles are found there, but it had its name from the Indians on account of its fancied resemblance to that animal. It has quite many lakes, drained by rivulets which flow to the Souris. Where

man has not interfered, it has a beautiful growth of *Quercus macrocarpa, Populus balsamifera candicans, deltoides* and *tremuloides, Betula papyrifera, Acer fraxinifolium, Fraxinus lanceolata, Ulmus fulva, Prunus pennsylvanica,* etc.,and plants like *Unifolium canadense, Limnorchis hyperborea, Streptopus roseus, Doellingeria umbellata pubens, Aster Saundersii, Rudbeckia ampla, Erigeron lonchophyllus,* etc., showing its tendency for making selections from different floras. The Souris enters the state from Canada, runs south, makes a bend, and returns to Canada. This bend has a length of about 75 miles and a width of 40 miles. In Canada it joins the Saskatsjavan River on its way to Lake Winnipeg, the same lake being the outlet for the Red River of the North, before all these waters jointly make a final dash for Hudson Bay. The flora of the Souris basin and adjoining prairies north and south of the Canadian boundary shows a striking similarity. In the early September anno 1902 I made an excursion to Assiniboia, 175 miles north of the boundary line, anticipating a rich harvest of Canadian fall plants. Along the track were growing everywhere *Helenium montanum,* a common North Dakota plant, and a beautiful *Coreopsis,* which I expected to collect when the train stopped at some station. But the Canadian stations were just like all other stations. *Chenopodium album, Sinapsis arvensis, Bursa Bursa-pastoris* and other familiar plants were the only floral representatives there. All native plants shun the stations. I failed to collect that *Coreopsis.* I left the train at Moose Jaw, searched the prairie, the waste places, the gravel pits and the thickets along the Saskatsjavan River, and but for one *Rosa* species and one variety of *Aster laevis* I found only old North Dakota acquaintances. On the other hand, one plant, accredited as exclusively Canadian, Bicknell's *Sisyrhinchium septentrionale,* grows a few rods from my residence lot at Leeds, North Dakota.

I have a limited knowledge of the flora west of the great divide. On May 2, 1903, I made an excursion lasting one hour, while I was waiting for the fast express train at Williston. I collected five species belonging to the Montana flora. East of the Coteau you will at this early season find only the flowers (not the leaves) of *Pulsatilla Ludoviciana.*

The woodland flora of the east is naturally best represented in protected localities where trees can grow. When entering such a wooded piece of land, you find that the change from the prairie flora is instantaneous. Very few plants adapt themselves to both conditions. Such a plant is *Steironema ciliatum,* which has a very rank and luxurious growth in the thicket, but dwindles down to half its ordinary size on the prairie. Another such plant is *Galium boreale,* which reaches

a gigantic size, often several feet high, in the timber, and, as variety *linearifolium*, shrinks into dwarfish proportions on the prairie, having an intermediate size in localities only partly protected. But besides this flora of eastern affinities, the woodland has a flora of its own, although representatives of this class are not as numerous as would have been expected.

It is on the prairie east of the great plateau that all the four floras meet. Minnesota and Assiniboia contribute largely to it, and many plants for which the manuals set Nebraska as their northern boundary, grow here. And numerous Montana and Wyoming species jump the barrier. A conspicuous peculiarity of this flora is the abundance of varieties. You examine a plant with the aid of a manual, and the description is just as made for that special plant but for one or two characters, and you will often be in doubt if that variety actually ought to have its own Latin name or not. No doubt the four different floras share the responsibility of these aberrations.

Immense spaces of the territory have never been visited by botanists, except as Government survey parties have passed across the country. The plow is incessantly doing its deadly work, it may be exterminating species that never were published.

Leeds, North Dakota.

Migration of Birds in St. Joseph County, Indiana.

BROTHER ALPHONSUS, C. S. C.

Some species of birds that arrived early in the spring of 1909 departed late in the summer. Such were the Cowbird, Red-winged Blackbird, Purple Grackle, Vesper Sparrow and Loggerhead Shrike. The Cuckoos, among the latest of the migrants to arrive in the spring of the year, departed early in the autumn.

Individuals of certain species that had departed were seen on one or more days a considerable time after the dates of their departure. The Vesper Sparrow was found Oct. 1; the Cowbird, Oct. 4, 5, 15, 16; the Purple Grackle, Oct. 6, 9; the Yellow-throated Vireo, Oct. 11; the Towhee, Nov. 15; the Robin, Nov. 26; the Dove, Oct. 24 and Nov. 29.

The Bobolink, Dickcissel, Crested Flycatcher, Rose-breasted Grosbeak, Scarlet Tanager, Yellow Warbler and Whip-poor-will were not seen after the 14th of August. The writer having been absent from the county for six weeks

previous to this date, could not obtain the dates of the departure of these seven species.

Aug. 18, Cowbird
" 26, Red-winged Blackbird
" 29, Hermit Thrush arrived
Sept. 2, Kingbird
" 3, Orchard Oriole
" 4, Hummingbird
" 4, Baltimore Oriole
" 4, Vesper Sparrow
" 6, Barn Swallow
" 6, Loggerhead Shrike
" 8, Purple Martin
" 8, Long-billed Marsh Wren
" 11, Least Flycatcher
" 15, Yellow Palm Warbler arrived
" 15, Purple Grackle
" 16, Warbling Vireo
" 17, Red-eyed Vireo
" 20, Redstart
" 21, Maryland Yellow-throat
" 23, Cedarbird
" 24, Red-headed Woodpecker
" 24, Wood Pewee
" 24, White-crowned Sparrow arrived
" 24, Yellowlegs
" 25, Golden-crowned Kinglet arrived
" 25, Brown Creeper arrived
" 25, Myrtle Warbler arrived
" 26, Snowbird arrived
" 26, Nashville Warbler
" 26, Catbird
" 26, Indigo Bird
" 28, White-throated Sparrow arrived
Sept. 28, Yellow-throated Vireo
" 30, Red-breasted Nut-hatch arrived
" 30, Black-billed Cuckoo
Oct. 1, Myrtle Warbler
" 4, Yellow-bellied Sap-sucker arrived
" 4, Chimney Swift
" 4, Kirtland Warbler
" 7, Yellow-billed Cuckoo
" 9, Mourning Dove
" 10, Yellow-bellied Sap-sucker
" 10, Phoebe
" 12, Brown Thrasher
" 13, Nighthawk
" 13, Belted Kingfisher
" 15, Yellow Palm Warbler
" 16, House Wren
" 19, White-crowned Sparrow
" 21, Bluebird
" 22, Hermit Thrush
" 23, Fox Sparrow
" 28, Meadowlark
" 28, Towhee
" 29, Chipping Sparrow
" 30, Hell Diver
Nov. 1, White-throated Sparrow
" 1, Killdeer
" 4, Robin
" 8, Song Sparrow
" 9, Tree Sparrow arrived
" 16, Goldfinch
" 18, Flicker
" 20, Golden-crowned Kinglet
" 20, Cardinal
" 29, Northern Shrike arrived

Tentative List of Birds of St. Joseph County, Indiana.

BROTHER ALPHONSUS, C. S. C.

(CONTINUED.)

ABBREVIATIONS:

S. V.—Spring Visitant; A. V.—Autumn Visitant;
S. R.—Summer Resident; W. R.—Winter Resident.

Empidonax minimus, Least Flycatcher, S. V.
Zonatrichia albicollis, White-throated Sparrow, A. V.
Spizella monticola, Tree Sparrow, W. R.
Melospiza georgiana, Swamp Sparrow, S. R.
Passerella iliaca, Fox Sparrow, A. V.
Spiza americana, Dickcissel, S. R.
Petrochelidon lunifrons, Cliff Swallow, S. R.
Iridoprocne bicolor, Tree Swallow, S. R.
Cotyle riparia, Bank Swallow, S. R.
Lanius borealis, Northern Shrike, A. V.
Lanivireo flavifrons, Yellow-throated Vireo, S. R.
Helminthophila rubicapilla, Nashville Warbler, A. V.
Helminthophila peregrima, Tennessee Warbler, S. V.
Dendroica caerulescens, Black-throated Blue Warbler, S. V.
Dendroica coronata, Myrtle Warbler, S. V.
Dendroica castanea, Bay-breasted Warbler, S. V.
Dendroica striata, Black-poll Warbler, S. V.
Dendroica kirtlandi, Kirtland Warbler, A. V.
Dendroica palmarum, Yellow Palm Warbler, S. V.
Opornornis formosa, Kentucky Warbler, S. V.
Wilsonia citrina, Hooded Warbler, S. V.
Wilsonia pusilla, Wilson Warbler, S. V.
Wilsonia canadensis, Canadian Warbler, S. V.
Seiurus aurocapillus, Ovenbird, S. R.
Sitta canadensis, Red-breasted Nuthatch, A. V.
Hylocichla fuscescens, Wilson Thrush, S. R.

Notes on Priority of Plant Names.

J. A. NIEUWLAND.

In Piper's Flora of Washington we have noted the use of the name *Rapuntium* for the genus *Lobelia*. It is not quite plain to us whether the author really intends to use the afore-

said name to supplant the name of Linnaeus accepted for so long a time or propose it as a segregated genus. No doubt *Rapuntium* is the valid name for what is now called *Lobelia* on the basis of absolute historic priority as it is the oldest name for the group of plants. The name was first applied by Columna in 1649, but Linnaeus is his Species Plantarum suppressed the name for no very good reason, as he did in cases of a great many other perfectly valid names. The only way in which *Rapuntium* could be consistently accepted would be to reject 1753 as the "starting point" for plant nomenclature. That this was not the intention of the author appears from the fact that other names published in the work falling under the same category were not changed. If he accepts *Rapuntium* for *Lobelia* he must also accept for similar reasons *Caprifolium* or *Periclymenum* for *Lonicera, Rorella* or *Salsirora* for *Drosera, Capnorchis* for *Bikukulla, Lapathum* for *Rumex,* and *Orchiastrum* for *Ibidium* or *Gyrostachys* and so of others. It is not likely that the author should have intended to reject the rule of 1753 as a "starting point" evident also from the fact that in the introduction to the work it is stated he "intends to follow the recently proposed Philadelphia Code." The genera of the *Flora of Washington* are not credited to any particular author, except certain instances, and in the case in question it seems to have been intended as a synonym of *Lobelia* or as a segregate thereof, as the latter name appears in small type after the word *Rapuntium.* If it was intended by the author as a segregate of *Lobelia* with the two plants mentioned as members of the new genus, even then *Rapuntium* is not the correct name. Two species are mentioned *Rapuntium Dortmanna,* (L) Presl. (*Lobelia Dortmanna* (L) 1753) and *Rapuntium Kalmii* (L) Presl. 1836 (*Lobelia Kalmii* Linn. 1753).

As *Rapuntium Dortmanna* (L) Presl. is given first one would intimate that on this supposition it was intended as the type of supposed new genus. Much as we would like to see the good old name *Rapuntium* restored as the proper name for the genus *Lobelia* as now accepted, we feel that the application of such older names for newly made genera is inappropriate as they may become homonyms should 1753 at any time cease to remain the "starting point" for nomenclature. In the case in question, however, *Rapuntium* is not the oldest name since 1753 for any proposed genus with *Lobelia Dortmanna* as a type. John Hill in 1756 segregated this plant from Linnaeus' aggregate genus under the name *Dortmanna,* which would be the oldest name under the "rules" and the name for any segregated genus of Lobelia containing what has until now been called *Lobelia Dortmanna,* Linn.

PRIORITY OF NEGUNDO.

Acer Negundo Linn. has been regarded by some authors as sufficiently different from the Maples to constitute the type of a separate genus. As such it had been called *Negundo aceroides* by Moench, in 1794*, until it was found that the older name *Rulac* Adanson, 1763‡, was to be applied. The species was called *Rulac Negundo* (Linn.) in later works.

Negundo as a genus name given to the plant before Linnaeus is, however, the oldest post-Linnaean name as well; for Boehmer restored it in his edition of Ludwig's Definitiones Plantarum Generum in 1760 thus antedating Adanson's name by several years.

Negundo (J. Ray) Ludwig-Boehmer, (1760).
Rulac, Adanson, 1763.
Negundo, Moench, 1794.
Acer, Linn., seg.

(1) *Negundo Aceroides,* Moench, 1794.
Acer Negundo, Linn., 1753.
(*Negundo Negundo* (Linn.) Karst.)
Rulac Negundo (Linn.) A. S. Hitchkock.

(2) *Negundo texana* (Pax).
Rulac texana (Pax) Small.

ABUTILON AVICENNAE.

In the seventh edition of Gray's Manual the name of the plant hitherto called *Abutilon avicennae* Gaertner, has been changed to that of *Abutilon Theophrasti* Medikus. The former name seems to have priority in its favor, and the binary, *Abutilon avicennae* was applied by Grotjan* in 1759. The work of Medikus on the *Malvaceae* was published in 1787, and Grotjan's binary was used before any work was recorded of Medikus. Accordingly for those who do not countenance duplicate binaries like *Abutilon Abutilon*; which the Vienna Con-

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* Moench, C. Methodus Plantarum, Page 334, 1794.
‡ Adanson, M. Familles des Plantes, 1763.
† Small J. K. Flora of the S. E. United States, 1903.
‡ Rydberg, P. A. Flora of Colorado, 1906.
Ludwig-Boehmer. Definitiones Plantarum Generum, 1760.

* Grotjan, J. A., Ergötzende Sommerbelustigung, Leipzig und Nordhausen, bey Johan Heinrich Grosz, 1759.

gress rightly condemned, *Abutilon avicennae* Grotjan, 1759, and the most commonly used name until the publication of Gray's Manual, seventh edition, is the correct and older name for the plant.

GROSSULARIA.

In the new Flora of North America, vol. 22, Part 3, the Gooseberries are segregated from the Currants (*Ribes*, Linn.) and the name *Grossularia* (Tour.) P. Miller,* 1759, is given to the segregated genus. Tournefort, however, used the name for both the currants and the gooseberries in the same sense that Linnaeus used the name *Ribes*. In 1755, Duhamel† restored the name *Grossularia* in the same sense that it was used by Tournefort and about four years earlier than Phillip Miller used it, so that the name should be attributed to Duhamel by those who follow the rules of the Vienna Code.

Grossularia, Duhamel, 1755.
Grossularia, P. Miller, 1759.
(*Ribes*, Linn. seg.)

Priority of Merulius.

J. A. NIEUWLAND.

In the new North American Flora, vol. 9, p 167, the name *Chanterel* Adanson, 1763, is proposed as the correct one for the genus segregated from the Linnaean aggregate *Agaricus*, and having as its type *Agaricus Chantarellus*, Linn. 1753. Boehmer ‡ in Ludwig's *Definitiones Plantarum* restored Haller's name *Merulius*, and it enjoys priority over Adanson's name by three years.

ERRATUM.

Page 120, etc., for *Jasperite* read *Jaspilite*.

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* P. Miller. Gardeners' Dictionary 7th. edition, 1759.
† Duhamel du Monceau. Traite des Arbres et Arbustes, 1755.
‡ Ludwig-Boehmer, Definitiones Generum Plantarum. Lipsiae, 1760, page 492.

Aquilegia scopulorum Tm.

PLATE XI. TIDESTROM on AQUILEGIA.

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Species of Aquilegia Growing in Utah and in Adjacent Portions of Colorado, Idaho and Arizona.

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During the seasons of 1907-09, while botanizing on the Uncompahgre Plateau, Western Colorado, in the Wasatch Mountains, Central Utah, and on the Kaibab Plateau, Northern Arizona, I collected a number of *Aquilegiae*, which proved of particular interest especially so far as the distribution of the species is concerned. Of the species listed by Dr. Rydberg for Colorado, I observed particularly *A. coerulea*, *A. elegantula* and *A. micrantha.*

The first mentioned appears to be not only the most widely distributed species but has also the distinction of being the State flower of Colorado. It occurs throughout Colorado at the higher elevations, usually at 2400 m. and upwards and is very abundant in places on the Uncompahgre Plateau, where I have observed it. This handsome species was first mentioned by James (Long's Expedition, 2:15, 1823) and later described by Doctor Torrey (Ann. Lyc. N. Y. 2:164, 1828). It is readily recognized by its large bi-colored flowers, the sepals being light blue, the petals blue and white. It was illustrated by Hooker (Bot. Mag. 90:t. 5477, 1864), and is too well known to require a description here.

In the Wasatch Mountains we find a white form growing under practically the same conditions as the Colorado plant and differing in no particular from the latter except in the color of the sepals. It was first noticed by Nuttall and described by him under the name *A. leptocera* (Nutt. in Journ. Acad. Sc. Phila. 7:9, 1834) and also illustrated by Hooker (Bot. Mag. t. 4407, 1848). It was described by Doctor Gray as *A. coerulea* var. *albiflora* (Robinson, Gray Syn. Fl. 1:44 1895). At first I thought the Utah form merited recognition as a species but on August 27, 1908, while botanizing on the slopes of Mount Terrell, Central Utah, I met with typical *A. coerulea* growing with the typical Utah form and varying in-

* **April 15, 1910.—Pages 165 to 196.**

to the latter. With white forms occasionally observed in Colorado amidst typical plants and the reverse obtaining in Utah, no definite specific line can possibly be drawn between the two forms, so Doctor Gray's name is not only appropriate for the Utah form but it is also indicative of its relationship to *A. coerulea.* The forms appear to thrive best in the Aspen region.

On June 27, 1909, while riding over the Kaibab Plateau from Ryan, Arizona, to the Grand Cañon, I observed a very graceful form of an *Aquilegia* hitherto unknown to me. It is frequent in the vast *Pinus ponderosa* area for which the plateau is famous; its position in the system appears to lie between the *A. coerulea* group and *A. chrysantha.* To the former it is related by its sometimes faintly bluish sepals while the long and very slender spurs remind one of *A. chrysantha.* The latter species I collected in April, 1908, on a similar yellow pine (*Pinus ponderosa Mayriana*) area in the Huachuca Mountains, Arizona.

Aquilegia pinetorum nov. sp.

In *A. chrysantha* the length of the sepals to that of the spurs may be expressed by the ratio 7:11, while in the new form the relation is 3:7, or, reduced to a common denominator, the relations will be expressed by 6:10 and 4:10 respectively. In *A. coerulea* the relation is 7:10. It is true that the length of the spur in *A. chrysantha*, and for that matter in many if not in all of the "spurred" species, is a variable quantity; yet the differences are too great to allow our form to be referred to either *A. coerulea* or *A. chrysantha.* The petals in *A. chrysantha* are commonly 12 mm. in length (excluding the spurs), with a rounded or broad and somewhat truncate apex. In our form, on the other hand, the petals approach more nearly the form and size of those of *A. coerulea.* The following diagnosis will serve to further elucidate the species.

Herba perennis, 4 dm. v. altior: caules pauci e caudice crasso, supra ramosi, pubescentes v. glabori: folia basilaria numerosa, 2-ternata; petioli graciles, 10-15 cm. longi, basi dilatati; petioli secundarii paene filiformes, 1-4 cm. longi, petioluli filiformes, 0.5 - 1 cm. longi, pubescentes; foliola 2-3-fida, segmentis inciso-rotundato-lobatis, basi rotundata v. cuneata, supra viridia subtus glaucescentia; caulinia minora ternata, simpliciora: flores magni (*A. coerulea* minores) albi; sepala ovato-oblonga, acuta, basi contracta, 3 cm. plus minusve longa, alba v. saepe coerulea; petala spatulata, apice rotundata, calcaribus rectis, tenuibus, 7 cm. plus minusve longis; stamina petala superantia, inaequalia, antheris oblon-

gis, 2 mm. longis; staminodia membranacea; ovaria pubescentia, stylis rectis stamina superantibus; folliculi ignoti.

Hab. In the *Pinus ponderosa* area, Buckskin Mountains, Northern Arizona. (*Tidestrom*, no. 2328, June 28, 1909.)

There is another species, *A. longissima* Gray, which is still more remarkable on account of the length of the spurs. In this species we find the spur sometimes over 1 dm. in length and the relation of the length of the sepals to that of the spurs is sometimes 2.5:10. Of *A. longissima*, I have seen only two specimens, one collected by Dr. E. Palmer in the Caracol Mountains, Coahuila, Mexico, and the other by Dr. V. Havard, in Los Chisos Mountains, Texas, near the Mexican boundary. *A. longissima* differs from our plant by its greater height; by its much larger leaves, with petioles sometimes 3 dm. or longer; and by its linear-oblong sepals.

On August 22, 1908, while riding over the Wasatch Plateau, near the eminence called Wasatch Peak, I met with another *Aquilegia* which does not appear to be related to any of the above mentioned species. It grew at an altitude of 3150 m., in the sand and among the gravel and loose rock which is so characteristic of certain slopes in the Wasatch Mountains. The plant is apparently sub-alpine and very rare, since I have not seen it in other similar localities,—not even on the Big Horse Shoe Summit (3600 m. alt.), some twenty-five miles northward, nor on Mount Terrell (3300 m.). The following is the diagnosis of our form:

Aquilegia scopulorum nov. sp.

Herba perennis, glabra v. supra pubescens, 1-2 dm. alta, multicaulis e radice crassa: folia basilaria 2-ternatisecta; petioli 4-6 cm. longi, basi dilatati; foliola conferta, sessilia, coriacea, venis obscuris, rotundata, basi truncata, trifida, v. lobata, 1 cm. plus minusve lata; caulinia ternata, simpliciora: flores albo-lutei v. albo-coerulei; sepala ovato-oblonga, pallide purpurea saepe coerulea; petala oblonga, apice rotundata, albida; calcaribus tenuibus, 3-5 cm. longis: stamina petala aequantia: ovaria pubescentia; styli tenues, 5 mm. longi; folliculi ignoti.

Hab. On gravelly slopes, Wasatch Peak, Central Utah. (*Tidestrom*, no. 1788, Aug. 22, 1908.)

This plant differs from *Aquilegia coerulea* var. *calcarea* Jones, by its cauline leaves, which in the latter form are 3-sected, with the lobes oval and entire. As to the leaf-form, f. *calcarea* is more closely related to *A. scopulorum* than to *A. coerulea*. In our plant the petioles as well as the leaf-blades and lower part of the stems are glabrous and glaucous. Mr. Jones, however, describes his form as having "petioles

very glandular-hairy, as well as the stems and peduncles." Mr. Jones found his form on a *Pinus ponderosa* area at an elevation of 2100 m., near Cannonville, Southern Utah, but our plant belongs to a region over 100 miles northward and grows at an elevation of nearly 3100 m.

July 8-9, 1908, while riding over the Wasatch Plateau towards Emery, Utah, I had the good fortune of traversing territory which hitherto has lain outside of the beaten path of botanists. While the plants of the plateau are fairly well known, since many species range northward and abound in more accessible regions; a great deal remains to be done in exploring the rugged regions immediately to the east and below the plateau. This region is marked by most rugged "box-cañons," of which "Muddy Creek Cañon" might be cited as a fair example. A little to the south of the latter lies one of the most inaccessible and, up to within two years, impassable, steep and very abrupt cañons. A trail, recently constructed by the Forest Service, enables one now to pass through this interesting region.

From the plateau (approximately 300 m. alt.) one descends the Muddy Creek onto a lower, smaller plateau-like area which is open for a distance of some six or seven miles and covered with a dense *Pinus scopulorum* forest eastward to a line where the "slope" is almost precipitous.

The cañon referred to above is one of the few means of descent from the plateau to the "eastern" desert. Here I found a number of interesting plants among which is the following:

Aquilegia rubicunda nov. sp.

Herba perennis pubescens, 1-3 dm. alta; caules pauci e radice crassa; folia basilaria petiolis elongatis 3-ternati-secta; petioluli filiformes; foliola 1 cm. plus minusve longa, basi truncata v. cuneata, segmentis cuneata tridentata v. varie lobata, lobis rotundatis: caulinia simpliciora; flores luteirubicundique; sepala avata acuta, rubicunda, 1 cm. plus minusve longa; petala spatulata, pallide lutea, apice rotundata 5-7 mm. longa, calcaribus gracilibus 2 cm. longis; stamina petalis duplo longiora; ovaria glabra, styli tenues; folliculi ignoti.

Hab. Among rocks along the "Link Trail," Manti Nat. Forest, Utah, near Emery. (elev. 2400 m.)

This form, which I at first referred to *A. elegantula* is distinguished from the latter by its uniformly tapering spurs and pink-colored sepals.

* *Flowers red with some yellow and green.*

† *Plants 3 dm. more or less in height, leaf-segments small.*

1. **A. elegantula** Greene, Pitt. 4:14, 1899. Rydb. Fl. Colo. 136, 1906.

Leaves mostly basal on long, slender petioles; flowers commonly 2 cm. in length, pendulous in anthesis; sepals ovate-oblong, greenish, 1 cm. long; the yellow laminae of the petals one half as long as the somewhat saccate, curved spurs; ovaries pubescent, style 15 mm. in length.

Southern Colorado. Mount Carbon. (Tm. 2202).

†† *Plants taller, leaf-segments large.*

Spurs tapering uniformly.

2. **A. rubicunda** Tm.

Leaves on slender petioles sometimes 2 dm. long; flowers commonly 3 cm. in length, pendulous in anthesis; sepals oval, acute, pinkish, 1 cm. long; the light yellow laminae of the petals one-fourth as long as the slender spurs; ovaries glabrous.

Wasatch Mts., Central Utah. (Tm. 2400.)

Spurs somewhat saccate curved.

3. **A.formosa** Fischer in DC. prodr. 1:50, 1824. T. & G. Flora 1:30, 1838. Planch. Fl. des Serres 8:125, t. 795. Gray, Syn. Fl. 1:44, 1895.

A. canadensis var. *formosa.* Wats. Bot. King's Exp. 10, 1871.

Leaves on long petioles; lateral leaflets nearly sessile, the terminal short-stalked; flowers nearly 3 cm. in length, pendulous in anthesis; sepals ovate-lanceolate, acute, 1 cm. or longer; the yellow, truncate or rounded laminae of the petals 5 mm. or longer, the red spur twice as long: ovaries pubescent, styles 1 cm. or longer.

Western Utah and Idaho and westward. (Sawtooth Mts. Idaho. Tm. 2560 and 2785.)

** *Flowers blue with some white or varying to white.*

† *Flowers small.*

4. **A. saximontana** Rydb. in Gray, Syn. Fl. 1:43, 1895; Fl. Colo. 136.

Glabrous, 2 dm. more or less in height; leaves small; sepals oval-oblong, 1 cm. in length; the yellow laminae of the petals somewhat shorter than the sepals and exceeding the blue, hooked spur; ovaries glabrous.

Colorado.

†† *Flowers large.*

§ *Spurs 3 cm. more or less in length.*

a. Sepals light blue.

5. **A. coerulea** James in Long's Exp. 2:15, 1823. Torr. Ann. Lyc. N. Y. 2:164, 1828. Hook. Bot. Mag. t. 5477. 1864. Gray, Syn. Fl. 1:44, Rydb. l. c. 136.

3-6 dm. in height; sepals ovate-oblong, 2.5-3.5 cm. in length, the white laminae of the petals rounded, one-half as long as the blue, slender spurs.

Aspen and Spruce Regions, Colorado. Mount Terrell, Utah. (Tm. 1815.)

aa. Sepals white.

6. **A. coerulea albiflora** Gray, Syn. Fl. 1:44, 1895.
A. leptocera Nutt. Journ. Acad. Phila. 7:9, 1834.
A. leptoceras Hook. Bot. Mag. 1. 4407, 1848.
A. coerulea Wats. Bot. King's Exp. 10, 1871.
A. coerulea var. *ochroleuca* Hook l. c. under t. 5477.

This form appears to differ from *A. coerulea* only in its white sepals.

Aspen and Spruce Regions, Wasatch Mountains, Utah.

§§ *Spurs 6 cm. or longer.*

7. **A. pinetorum** Tm.

Differs from the preceeding species by its more slender form and much longer spurs.

Pinus ponderosa Region, Buckskin Mts.,Arizona. (Tm.2339.)

*** *Flowers blue with some purple, yellow or cream-white or entirely purplish white.*

† *Glabrous below, sometimes pubescent above.*

8. **A. scopulorum** Tm. (Plate XI.)

1-2 dm. high from a multicipital caudex; leaves small, leaflets crowded; sepals ovate-oblong, blue or pale purple; petals oblong, whitish; spurs slender, 3-5 cm. in length; ovaries pubes, cent; styles slender, 5 mm. long.

Subalpine Regions, Wasatch Mts. Utah. (Tm. 1788.)

†† *Glandular-hairy.*

9. **A. scopulorum f. calcarea** (Jones) Tm.
A. caerulea var. *calcarea* Jones, Proc. Calif. Acad. Sc. Ser. II, 5:619, 1895.

Pinus ponderosa area near Cannonville, S. Utah, alt. 2100 m. Jones.

**** *Flowers yellow.*

† *Spur wanting.*

10. **A. Eastwoodiae** Rydb. Bull Torr. Bot. Cl. 29:146, 1902; Fl. Colo. 136.
A. ecalcarata Eastw. Zoe, 2:226, 1891; 4:3, 1893; Cal.Acad. Sc. Ser. II, 4.560, t. 18 in 1895. Gray, Syn. Fl. 1:43.

I have seen no specimens of this species.

S. W. Colorado.

· †† *Spur 2 cm. or shorter.*

§ *Glandular-pubescent.*

11. **A. micrantha** Eastw. Proc. Calif. Acad. Sc. Ser. II, 4:559, t. 19. Gray, Syn. Fl. 1:43. Rydb. l. c. 136.

A slender species, 3 dm. or taller; leaves on short petioles; flowers 2 cm. or somewhat longer; sepals ovate-oblong, acute, 1 cm. long; petals truncate or nearly so, spur slender: follicles 1 cm. or somewhat longer, viscid-pubescent.

In cañons, S. E. Utah and southward.

§§ *Glabrous or nearly so.*

12. **A. flavescens** Wats. Bot. King's Exp. 10, 1871. Gray, Syn. Fl. 1:43.

A. canadensis var. *aurea* Regel, Gartenfl. 21:t, 734.

5 dm. or higher, branching; leaves on long petioles; sepals ovate-oblong, spreading, 1.5-2 cm. long; the broad laminae of the petals one-half as long as the somewhat curved spur; follicles 2 cm. in length, pubescent.

Aspen and Spruce Regions, Wasatch Mountains, Utah.

A. flavescens f. minor, Subalpine, smaller and more hairy. Wasatch Plateau. (Tm.)

††† *Spur 4 cm. or longer.*

13. **A. chrycantha** Gray, Proc. Am. Acad. 8:621, 1873; Syn. Fl. 1:44, Masters, Gard. Chron. 1873, f. 304, Rydb. l. c. 137.

A. leptocera var. *chrysantha* Hook. f. Bot. Mag. t. 6073, 1873.

5 dm. or taller, glabrous below; sepals lanceolate-oblong, 2 cm. or longer; the slender spur about four times as long as the broad laminae of the petals; follicles 2 cm. or longer.

Southern Colorado and southward.

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An Analytic Study of Faunal Changes in Indiana.

WALTER L. HAHN.

REPTILES AND AMPHIBIANS.

We have less direct evidence regarding present and former numbers of these classes than any other conspicuous group in our fauna. Several local histories mention snakes and es-

pecially, the abundance of rattlesnakes. There is no direct evidence as to comparative abundance of the smaller snakes, turtles, frogs and salamanders of the past and present. Their ecological position gives us some idea as to whether they are increasing or diminishing.

Snakes are universally disliked and most people will kill them whenever possible. Three venomous species were not uncommon in the State. The copperhead was abundant in the southern half, the prairie rattlesnake in the northern half and the banded rattlesnake was not uncommon in all parts. At the present time the latter species is practically extinct, the copperhead is rarely found except in rugged, uncultivated localities and the prairie rattler is limited to the vicinity of swamps and marshes.

These species have been systematically hunted down by man in defense of himself and his property. Other species that are reported venomous, as the black snake or blue racer, and the hog nosed snake or spreading viper have shared their fate.

The garter snakes and water snakes are much more prolific, and being rather timid and living chiefly in rank vegetation, not near houses, they have maintained their place in the fauna much better. All species have suffered destruction by hogs and it is doubtful whether any of the more common serpents are as numerous now as a century ago.

Turtles also have diminished in abundance. Hogs eat them as well as snakes (Culbertson, '07), and probably exerted a very great influence upon the reptilian and amphibian fauna in the days when they were permitted the freedom of the woods. Ponds and marshes have been drained, creeks have dried as the result of deforestation, and lake shores which were formerly used as breeding grounds by turtles are now occupied by human habitations. All of these things have tended to diminish their number.

Amphibians have been acted upon by the same influences as turtles. There is this difference, however, turtles were practically immune from attack by wild creatures of the forest. Frogs and salamanders were eaten by snakes, waterfowl, opossums, raccoons and other carnivorous animals. Most of these species have been greatly reduced and hence the frogs have lost many enemies. Man is not usually an active enemy of these creatures, hence his influence upon them is principally indirect and consists in draining swamps and reducing land

to cultivation. As there are pools of water left in every community, the animals are not entirely dispossessed of breeding places. On the whole, it does not seem probable that the amphibians have greatly diminished in number as a result of the settling of the State.

FISHES.

Fishes, both large and small, were abundant in the waters of Indiana during the early days of settlement. The shovel-nosed sturgeon, paddle fish, buffalo, alligator-gar and many others grew to considerable size and contended for supremacy in the rivers and streams of the southern part of the State, while muskallunge, whitefish, lake sturgeon, cisco and others were abundant in the northern lakes. The pioneers speared, gigged, trapped and seined them without let or hindrance. Naturally, the best time to capture many of them was while they were ascending the smaller streams to spawn. By the light of torches or blazing bonfires along the bank many pounds of fish could be speared or gigged in a single night. But they were often taken before spawning and the next generation was lost. The only possible result was the diminution of many of the larger species.

Large fish live for the most part upon the smaller ones. How have these fared? Have they been given added opportunities as some of the smaller birds and mammals have?

The problem is not by any means the same, for the fish fauna is closely dependent upon the character of the streams as well as food and protection. In the northern part of the State there were many lakes, some of them quite deep, some mere marshes, but all with more or less of shallow, reedy margins. The outlets were generally sluggish and consequently more or less choked by aquatic plants. The shallow parts of the lakes are easily drained and make exceedingly fertile land. In many places lake levels have been lowered several feet by cutting ditches and straightening the channels of the outlets. At other points, entire lakes or marshes have been drained in the same way; the most notable instances being Beaver Lake and English Lake. The water area in this region has therefore been considerably lessened and drainage has often progressed rapidly enough to destroy large colonies of aquatic plants and animals, thereby lessening the food supply for the fishes and occasionally killing fishes themselves.

In the southern part of the State there were few lakes and marshes but many streams. Deforestation has had a tremendous influence upon the character of the streams. The one that has been longest familiar to the writer is Willow

Creek, in Ohio County. This is a small stream with a bed in shale and soft limestone. Twenty years ago the hills bordering it were almost all covered by forests. The creek had many pools two or three feet deep and from one to several rods long. The stream flowed most of the year and even during droughts the pools contained much water, pure enough to afford homes for fishes. The stream was too small to support large species, but bullheads, sunfishes and several species of minnows and suckers were abundant and were frequently caught on hook and line.

At the present time the forests are cleared and all the hills bordering the stream are under cultivation unless too rocky and barren to produce a crop. The stream has lowered its bed noticeably (probably two feet on the average in 20 years) and the character of the stream is greatly changed. Now it flows only during the wet months of the year, ceasing soon after the flow of surface water is exhausted, but becoming a raging, unfordable torrent after heavy rains. The floods have changed the character of the stream, bed so that large pools no longer occur in times of drought only a few small, stagnant pools, fed by seepage from springs, can be found in the entire course of the stream. These contain no fishes large enough to take the hook, and only one or two small species of minnows inhabit them.

Willow Creek is here described because the writer has personal knowledge of the facts. It is typical of all the smaller streams that have cut their beds in the Ordovician rocks of southern Indiana and more or less typical of small streams throughout all the southern part of the State. Paradoxical as it at first seems, destruction of the forests has meant destruction of the fishes.

I know of but one direct comparison that has been made between past and present fish fauna of the same stream, and that has not been published heretofore. In 1885, and a few years previous, Eigenmann and others made extensive collections in Bean Blossom Creek, a tributary of White River, not far from Bloomington, Indiana. Altogether, 40 species were taken, 32 of them being collected in one day, September 12, 1885. In 1904 three experienced and energetic collectors, Dr. A. M. Banta, now of the Cold Spring Harbor Laboratory, of the Carnegie Institution; Dr. Newton Miller, now of Clark College, and W. L. McAtee, now of the Biological Survey, of the U. S. Department of Agriculture, collected fishes in the same stream with avowed intention of breaking the record for number of species. Collections were made on but a single day, May 24, and although their results might not compare with the list of Eigenmann, collected through a period of

several years, it should be as large as that taken in a single day nineteen years earlier, unless there was a change in the fauna.

The list of Banta, McAtee and Miller includes only twenty-four species, of which twenty-one were taken by Eigenmann and three are new to the stream.

The following is Eigenmann's list of 1885 with his comments upon their abundance. The nomenclature is not corrected to date but the common names are added. The species that were taken again in 1904 are checked thus *.

1. *Ammocoetes branchialis*, Brook lamprey. Abundant in spring.
2. *Noturus gyrinus*, Tadpole Cat. Two specimens.
3. **Noturus miurus*, Brindled Stonecat. Very abundant.
4. *Noturus flavus*, Stonecat. Very common.
5. *Noturus exilis*, Slender Stonecat. One specimen.
6. *Leptops olivarius*, Yellow Cat.
7. *Ameiurus melas*, Black Bullhead.
8. **Ameiurus natalis*, Yellow Bullhead.
9. **Catostomus teres*, Common sucker. Very abundant.
10. *Catostomus nigricans*, Hogsucker. Abundant.
11. **Minytrema melanops*, Spotted sucker. Abundant.
12. **Moxostoma macrolepidotum*, Red Horse.
13. **Campostoma anomalum*, Stone-roller.
14. *Chrosomus erythrogaster*, Red-bellied Dace.
15. *Hybognathus nuchalis*, Silvery Minnow.
16. **Notropis whipplii*, Silverfin.
17. **Notropis megalops*, Common Shiner.
18. **Notropis ardens lythrurus*, Blackfin.
19. *Rhynichthys atronasus*, Blacknosed Dace.
20. *Hybopsis biguttatus*, River Chub.
21. **Hybopsis amblops*, Silver Chub.
22. *Semotilus atromaculatus*, Horned Dace.
23. *Esox vermiculatus*, Little Pickerel.
24. *Labidesthes sicculus*, Brook Silverside. One specimen.
25. *Aphredoderus sayanus*, Pirate Perch. One specimen.
26. *Pomoxys annularis*, White Crappie. Very abundant.
27. *Pomoxys sparoides*, Calico Bass.
28. **Ambloplites rupestris*, Goggle-eye.
29. **Lepomis cyanellus*, Blue Sunfish.
30. **Lepomis megalotis*, Long-eared Sunfish. Abundant.
31. **Micropterus dolomieu*, Black Bass. Abundant.
32. **Boleosoma olmstedi maculatum*, Johnny Darter. Abundant.
33. *Diplesion blennoides*, Green-sided Darter. Abundant.
34. **Percina caprodes*, Log-Perch. Abundant.
35. **Hadropterus phoxocephalus*.

36. **Hadropterus scierus.* Abundant.
37. **Hadropterus aspro.*
38. **Etheostma flabellare*, Fan-tailed Darter. Abundant.
39. **Etheostma coeruleum*, Rainbow Darter.
40. *Uranidea richardsoni*, Miller's Thumb.

In addition the 1904 collection contained *Ericymba buccata*, Silver-mouthed Minnow; *Pimephales notatus*, Blunt-nosed Minnow, and *Phenacobius mirabilis*, Sucker-mouthed Minnow. Nineteen of the forty species taken in 1884 and 1885 were not found in the same stream 20 years later.

Nine of these, or 40 per cent., are large enough to be caught on a hook and the others, or 55 per cent., are too small to be taken in that way. Of the species that have disappeared, three small and two large ones were formerly abundant in the stream, three small ones were rare and the abundance of the others is not noted. Atogether, twelve of the nineteen species are either abundant or at least of common occurrence in this region, while the other seven are not very common.

Classified on the basis of food*, eleven of the exterminated species subsisted chiefly on animal food, five are either omnivorous or feed principally on mud, and the food of three is unknown to me.

Twenty-four species were taken in 1904. Of these eight, or $33\frac{1}{3}$ per cent., are large enough to be taken by fishermen and 16, or $66\frac{2}{3}$ per cent. are too small to take the hook. Twenty-two, or over 90 per cent, are common fishes of the region. Two species are rather rare. One of these, *Hadropterus scierus*, was first described from this stream and has since been taken in several states of the Mississippi basin, but is not as common as many of the darter family, of which it is a member. The other is the sucker-mouthed minnow, *Phenacobius mirabilis*, not heretofore reported from Indiana, but rather common in Illinois and farther west. Apparently it is migrating eastward.

Twelve of the collection of 1904 are reported to subsist principally on food of an animal nature, while five eat a considerable amount of vegetable matter. The food of the others is not known, but the majority of them probably subsist wholly or largely on animal food. In both lists, the great majority of fishes are those that prefer clear streams and rocky or sandy bottoms, as might be expected in a comparatively swift, rocky creek.

The presence of *Phenacobius mirabilis* is interesting although it may be without special significance. If the eastward migration of this species is part of a general movement, it is of extreme interest. The certainty of an eastward movement of birds has been pointed out and also the probability of such

a movement among mammals. Something similar is going on among the insects. In each of these classes it is undoubtedly the result of deforestation, but if there is a similar movement of the fishes, it is far more difficult to explain.

A comparison of percentage given above for the two periods seems to indicate that small species have a slight advantage, and that species numerous in the region are more apt to survive than those that are rare, without regard to their abundance in any particular stream. No tendency with regard to food is evident. It is of interest to note that but two of the seven cat fishes occurring at the earlier period were found at the later date, while only one of the eight darters had disappeared.

The data are insufficient to warrant any sweeping conclusions but a reduction in the number of species has taken place without question and it is, perhaps, the most significant fact to be learned from this study.

MOLLUSCA AND CRUSTACEA.

There is little information as to the former abundance of these two groups. Land snails are most abundant in the woods under decaying logs and leaves. With the exception of the slugs, they are not very common in cultivated or grassy land. It therefore seems evident that the land Mollusca are less abundant at the present time than formerly, for even in the remaining forest, the underbrush and logs are usually cleared away so that there are few places for them to deposit eggs.

Certain species of crayfishes live in burrows in marshy places more or less remote from large bodies of water. In such places they erect cylindrical stacks of mud about the entrance of their burrows and these "craw-fish chimneys" are conspicuous features of many poorly drained pastures and meadows. As land has become more valuable, these swampy places have been tiled or ditched and often placed under cultivation. Consequently they have become unfit for crustacean inhabitants and the latter must have diminished.

In the ponds, lakes and streams, the same conditions that affect the fish fauna (p. 174.) have acted upon the aquatic Crustacea and Mollusca. Deforestation has brought floods that have torn up stream bottoms in the course of an hour. Silt comes down from the hillsides by the ton and makes the water of the streams so dense that animal life can scarcely exist in them. Fishes are active creatures and have some chance of escaping into the more quiet pools and eddies, but the crayfish are sluggish and are crushed by overturning rocks and buried unde debris before they can escape. Much

less can the slow moving snails and mussels escape danger where the bottom on which they rest is torn up or buried inches deep under mud or stones, or where logs, plants or other objects to which snails cling are dashed against banks or whirled away by raging torrents.

Ponds and lakes are also made turbid by the silt of plowed fields and the smaller Crustacea are smothered by the muddy water. Draining destroys marshes and annihilates aquatic plants and animals by the billion. The larger lakes and rivers are doubtless affected less than the small ones, but the character of their waters also is changed and the weaker species must suffer in consequence. In recent years the pearl mussel industry has grown so rapidly that mussels have become scarce where they were once abundant and there is danger that they may be exterminated unless the industry is regulated.

In spite of the fact that we have no recorded information in regard to the former abundance of Mollusca and Crustacea, and little knowledge of their present number, there can be no doubt that both groups have diminished. With the exception of the river mussels, none of the species of either class found in the State have any direct value to man. They furnish, however, the basis of food supply for the vast majority of fishes and are also eaten by many birds. Their diminution is therefore an economic loss, although some of the conditions that have caused them to dimish may more than counterbalance the loss.

INSECTS.

Mr. Max Ellis, of Indiana University, has contributed the data and generalizations for this section of the paper, although his notes have been rewritten to form a connected account.

Probably many insects have increased, and several have been added to the fauna, by introduction or migration. Unfortunately we have little knowledge of the vast majority of species and this account is necessarily limited to a few of the larger species and a few of considerable economic importance. During the larval stage, many insects are dependent upon one or few species of plants for food, and since they have not the ability to move rapidly or far, their presence or absence in any locality may be determined by the presence or absence of a certain plant.

Butterflies are doubtless better known than any other insects and our knowledge of their range is more complete. Blatchley ('91) has published a list of the species known to occur in the State, with localities at which they had been re-

ported. Mr. Ellis has collected in most sections of the State during the past two or three years and we therefore have a means of determining changes that have taken place during the last eighteen years.

The giant sulphur, *Callidryas eubule*, was reported only from Vanderburgh County in 1891, where a local collector, S. G. Evans,"took from one to half a dozen almost every season." Mr. Ellis took three at Vincennes in 1906, several in 1907, and several in 1908, and says that it was very common there in 1909, as many as a dozen being seen in the course of an hour. The food plants are cassia, wild senna and clover. These are not of recent introduction and the present increase of the butterfly is not due to a change in food supply but probably to a northward migration along tributaries of the Mississippi.

The black swallowtail, *Papilio polyxenes*, was said by Blatchley to be, next to the giant swallowtail, the rarest butterfly of the group. Mr. Ellis says that it is now the most abundant of the swallowtails in every part of the State, and even one of the commonest of all butterflies. The larvae feed upon the wild parsnip and other *Umbelliferae* and these are, for the most part introduced plants that have become common only in recent years.

In six years collecting Blatchley saw only two living specimens of the giant swallowtail, *Papilio cresophontes*, finding none at Bloomington, "although a constant outlook has been kept for it." Ellis says it is still our rarest *Papilio*, but it is fairly common throughout the State. He has taken it at Bloomington, Mitchell, Shoals, Vevay, Indianapolis, Anderson and Winona Lake. I have myself seen as many as fifteen in one afternoon, my zoology class having taken ten or twelve in the course of an hour between Milford and Syracuse in Kosciusko County. The food plants are the hop tree and prickly ash and these must be on the decrease, although still common in many places. The reason for the increase of the butterfly is probably a northward and eastward migration of the species. This movement was noted some years ago by Edwards.

Scudder, in 1886, reported the gray emporer, *Chlorippe celtis*, from the extreme southwestern tip of Indiana. In 1891 Blatchley reported it as far north as Wabash but said that it was scarce everywhere. Ellis found it common on the State forestry reserve at Henryville, at Anderson and at Indianapolis, abundant at Vincennes and very abundant at Vevay. The larvae feed upon the hackberry tree. The species is southern and is probably working its way northward.

The harlequin cabbage bug, *Murgantia histrionica*, is a native of Guatemala and has migrated northward through

Mexico into Texas and thence spread slowly through the southern states. (Lugger, '00.) It was south of Virginia at the time of the civil war and in 1900 had reached New Jersey and Missouri. Since 1900, probably within the past five years, it has reached Indiana. It is a serious pest, eating cabbage, turnips, and other cruciferous plants, but has not yet become numerous enough to do much harm except in the southwestern corner of the State.

The striped potato beetle, *Leptinotarsa decemlineata*, probably came from Mexico in the first place, but first migrated northward along the eastern base of the rocky mountains to Colorado. There were no suitable food plants on the plains east of that region, until they were settled and crops of potatoes were planted. This condition was fulfilled about 1850 and the beetles then began an eastward migration, reaching Indiana in 1866. Since that time it has been a serious pest.

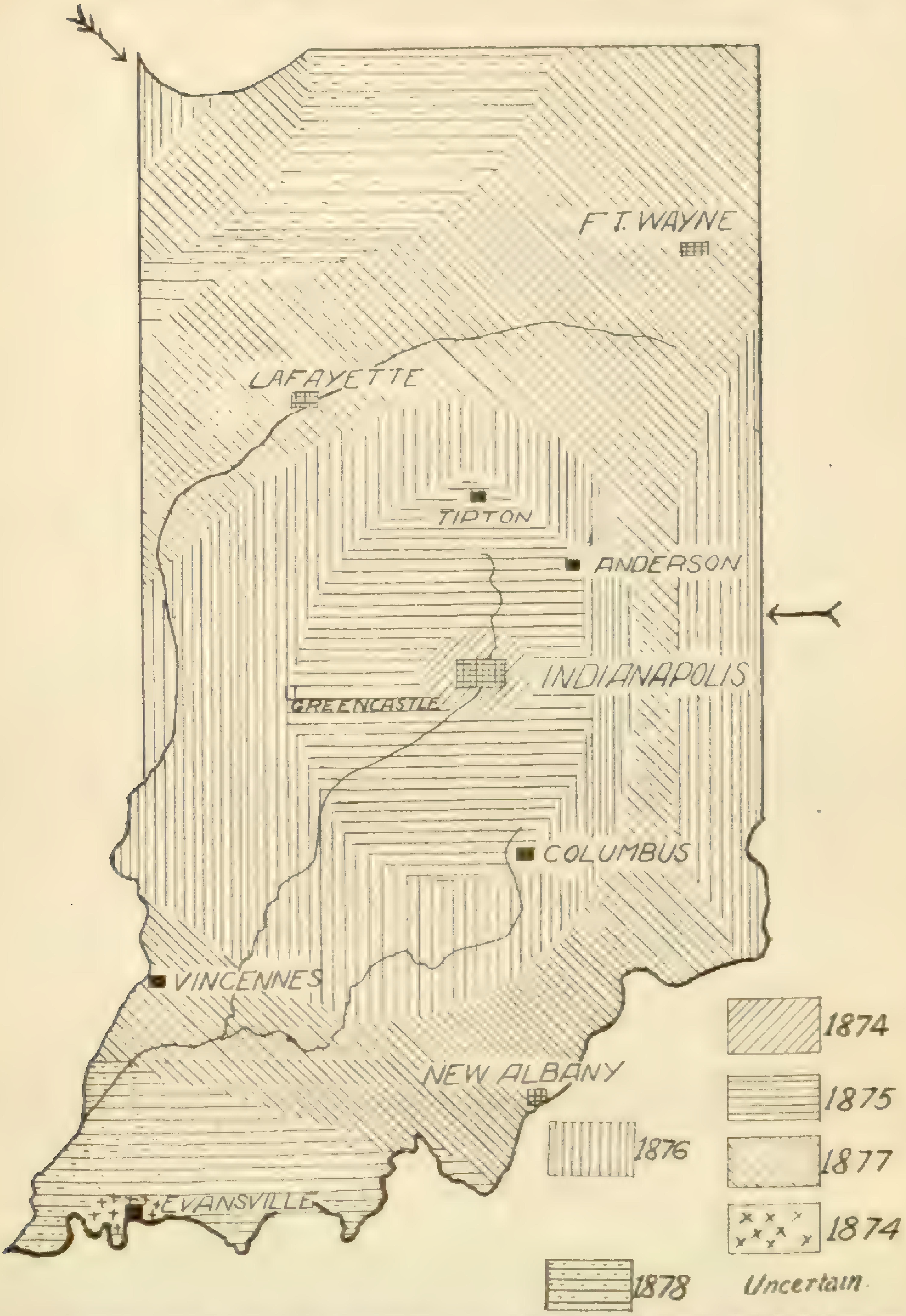
A number of insects have been introduced into the United States from Europe and have been carried to, or have migrated to Indiana.

The best known is the cabbage butterfly, *Pontia rapae*. It was introduced at Quebec in 1860 and first appeared in this State at Indianapolis in 1874. It was probably carried there by trains as the nearest point at which it was then known was Columbus, Ohio.

It spread from Indianapolis during 1874 and 1875, (see map), reaching Tipton, Anderson, Columbus and Greencastle during the latter year. In 1876 the main army, migrating through Ohio, reached Indiana and the next year the two divisions were united in the eastern part of the State. In 1876 the species also entered the northwestern part of the State from Chicago, and in 1878 this colony became joined to the main vanguard and the species had completely covered the State. The principal direction of migration of this species was westward, contrary to the usual course of the native species of the region. (Account based on Scudder, Butterflies of New England.)

The horn fly, *Hematobia serrata*, which is a pest on cattle during the summer, and the grape berry moth, *Eudemis botiana*, were also introduced from Europe, the former about 1886, the latter much earlier. The horn fly spread rapidly, reaching Indiana in about two years, and soon overspread all of the region east of the Rocky Mountains. The grape berry moth spread slowly and reached this State during the late nineties.

The San José scale was introduced into California about 1870. It was not discovered in the east until 1893, when it



Sketch map of Indiana showing the rapid dispersal of the cabbage butterfly, *Pontia rapæ*. There were three introductions, one at Indianapolis, the other two at the points and from the directions indicated by the arrows. There is also an uncertain record of a fourth introduction at Evansville.

Scale about 45 miles to the inch. Adapted from Scudder.

appeared in Virginia. It was found, however, that it had been introduced into Virginia from New Jersey in 1891. (Bull. No. 3, U. S. Bureau of Entomology, U. S. Dept. of Agriculture.) The same year it was introduced into Washington County, Indiana, on apple trees shipped from New Jersey, but it was not discovered until 1894. It has since appeared in many parts of the State, but its further spread is being checked by rigid inspection.

The imported elm leaf beetle, *Galerucella luteola*, was brought to this country in 1834, but was confined to the east until 1890, when it was carried to Kentucky. Ten years later it was introduced into Indiana at Tobacco Landing, Harrison County. It spread very slowly but was carried on trees or by wagons to Elizabeth and New Middleton, and has now spread over most of the southeastern third of that County. (See map.) It is not active in flight and hence spreads very slowly, except where it is carried. It crawls a great deal, however, and hence is sometimes carried by wagon.

Not every species of insect has increased. No doubt wood boring beetles, and forest insects of many kinds have decreased and some have even been exterminated. But we know these so little that it is not possible to point out many instances. However, the following species are known to have decreased:

The blue-eyed grayling, *Cercyonis alope*, appears to be diminishing. Scudder ('86) included the entire State in its range. Blatchley ('91) said that it was not found south of Wabash County. Ellis says that it is now more scarce than ever, being restricted to the three northern tiers of counties. The food plants are wild grasses and sedges. The butterfly frequents swampy woodlands and is being exterminated by the draining and pasturing of these.

Hornets, yellow jackets and many wasps are less numerous than formerly. They are destroyed by man at every opportunity because of the painful wounds which they inflict. Since they live in colonies, the destruction of a large number is an easy matter. Cultivation of the soil also destroys yellow jackets and other burrowing species.

The rhinoceros beetle, *Dynastes tityrus*, was once a common inhabitant of the forest. The larvae live in decaying wood and clearing the forest has removed much of their food supply. The large size and unusual appearance of the beetle has aided in its destruction by making it an object of curiosity and fear and consequently leading people to kill it. Its slow and clumsy movements have also hastened its destruction.

The walking stick, *Diaphemora femorata*, and the rear-

Sketch map of a part of Harrison County showing the slow dispersal of the imported elm leaf beetle, *Galerucella luteola*. Scale, about eight miles to the inch. In 1906 the beetle was found around Corydon, and from 1905 to 1906 around Elizabeth and New Middleton. [Data omited from the map by oversight.] Redrawn from the original of M. M. Ellis.

horse or praying mantis, *Stagomantis carolina*, were also common at one time. They are both of such extraordinary appearance as to attract attention and consequently both have been killed wantonly because people "do not like bugs." The former is known as the devil's darning needle and doubtless the word "devil" in association with it has created something of a superstitious fear for it. There has also been a reduction of mosquitoes and other aquatic insects, due to draining of marshy land.

To summarize the changes of insect fauna: The increase has been more marked than the decrease. A number of species have been introduced by man and some have migrated into the State. It is difficult to destroy the species that are pests because they are not easy to find, and many have a very rapid rate of reproduction. The introduced species have a good chance in the struggle for existence because they have few enemies and an abundant food supply.

The species native to the United States but new to Indiana have apparently migrated in from the south and west. The eastern migration is easily explained, as the prairie species from regions immediately west have only been able to find congenial homes and food after the forests were cleared. The northward migration is not so easily explained. May it be a part of the general northward movement of the temperate biota that followed the retreat of the ice sheet?

The insects that have diminished are aquatic or wood loving species whose homes or food have been destroyed, or they are species harmful to man, or they are of such unusual size or appearance as to attract notice.

GENERAL SUMMARY.

There is a tendency for certain ecological groups to disappear and for others to increase. Those that tend to disappear are:

1. Large species; not only have the larger species of the fauna, as bison and wapiti, disappeared, but the largest species of any natural group tend to disappear before the smaller species of the same group.

2. Aquatic species suffer from changes in the various bodies of water.

3. Forest-dwelling species are exterminated through loss of homes and food.

4. Species dangerous or supposedly dangerous to man are killed off.

5. Species economically injurious are actively destroyed *whenever possible*.

6. Species valued for sport or for any animal product are killed and tend to disappear; not one species native of Indiana has been domesticated.

7. Species that breed slowly tend to disappear. (These are usually large species with few enemies.)

8. Species with gregarious habits are more easily killed than those with solitary habits, hence tend to disappear.

The groups that tend to remain stationary or to increase are the following:

1. Small species.
2. Species that have a high birth rate.
3. Species that have: (a) great cunning, or (b) great timidity.
4. Prairie Species: there is unquestionable evidence of an eastward movement of the fauna, due to deforestation, and some indication of an unexplained northward movement.

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Our Birds in August and September.

BROTHER ALPHONSUS, C. S. C.

The autumn migration of certain species among the birds presents some inexplicable facts to the writer. He is unable to ascertain why the Cowbird, Red-winged Blackbird and Purple Grackle should leave even before the end of summer. They, being among the early spring arrivals, should naturally depart later, when most of the first spring migrants do. Another curious thing is the total absence of the Spotted Sandpiper from his summer haunts along the shores of lakes before he really migrates south. I have found this species near rivers long after leaving the lakes.

Certain species are absent from this locality for a considerable period and then reappear—some seldom and others often. Among the former are the Redstart, Phoebe, Nighthawk and Chickadee; among the latter is the Towhee. The writer is equally unable to account for the strange movements of these species.

As the season of migration advances, the various species that were abundant during summer begin to appear irregularly. This fact leads the writer to surmise that most of the species migrate gradually and in small numbers, leaving gaps in their distribution. Even those that migrate in large flocks do not disappear altogether. Individuals may be seen here and there for several days after the main body has departed.

Birds seen every day:

Song Sparrow	Chipping Sparrow
Blue Jay	

Birds not seen on any day:

Crested Flycatcher	Scarlet Tanager
Dickcissel	Yellow Warbler
Rose-breasted Grosbeak	Whip-poor-will
Phoebe	Nighthawk
Bobolink	Bobwhite

Birds seen every day except on the dates after their names:

Yellow-billed Cuckoo, 24, 28, 31. Sept. 4, 6, 8, 14, 18, 24 to 29.

Red-headed Woodpecker, Sep. 12 to 16, 18, 20, 21, 23 to 30.

Chimney Swift, 24, 29. Sept. 4, 7 to 11, 13 to 17, 19 to 27, 29, 30.

Wood Pewee, Sept. 12 to 17, 19 to 22, 24 to 30.

Baltimore Oriole, Sept. 1, 2, 4 to 30.

Goldfinch, 21.

Field Sparrow, 23, 28. Sept. 4, 5, 6, 9, 11 to 17, 21, 22, 23, 25 to 30.

Indigo Bird, 21, 27, 28, 30. Sept. 2, 9, 10, 11, 15, 16, 26 to 30.

Cedarbird, 14 to 17, 20, 21, 23, 24, 26 to 28, 30. Sept. 6, 9, 11, 13, 15, 17, 18, 21 23 to 30.

Brown Thrasher, 14, 27, 30. Sept. 9, 24, 30.

Belted Kingfisher, 14, 15, 18, 19, 20, 22, 24, 30, 31. Sept. 4, 6, 7, 8, 11, 13 to 17, 19, 24, 26, 29, 30.

Kingbird, 27. Sept. 2 to 30.

Crow, 14, 24. Sept. 6, 13, 16.

Flicker, 14, 23. Sept. 5, 6, 8, 14, 15, 18, 23, 24, 27, 28, 30.

Meadowlark, 14, 15, 24, 25, 27, 28, 29. Sept. 1, 2, 7, 8, 9, 12, 14, 16 to 20, 22.

Warbling Vireo, 14, 15, 20, 21, 24, 26. Sept. 3, 4, 9, 16 to 30.

Purple Grackle, 14. Sept. 5, 9 to 13, 15 to 30.

Barn Swallow, 14, 17, 19, 23, 24, 26, 27, 29. Sept. 4, 6 to 30.

Catbird, 14, 28. Sept. 14, 23, 24, 26 to 30.

Robin, Sept. 10, 14, 16, 17, 18, 28.

House Wren, 20, 23 to 26, 28. Sept. 3, 5, 10, 13, 14, 16, 18, 19, 21, 22, 25, 26, 28, 29, 30.

Mourning Dove, 16, 21, 24. Sept. 2, 3, 6, 10, 12 to 21, 24, 25, 26, 28, 29, 30.

White-breasted Nuthatch, 14, 30. Sept. 3, 5, 6, 13, 14, 16, 20, 22, 23, 26 to 30.

Downy Woodpecker, 14, 15 to 18, 21, 22. Sept. 1, 2, 4, 8, 13, 15, 17, 18, 21, 26, 28, 30.

Birds seen on the dates after their names:

Screech Owl, 18, 20, 22, 23, 26, 28, 30. Sept. 2, 6, 7, 8.

Cowbird, 14, 15, 16, 17.

Orchard Oriole, 17, 19, 22, 24, 29, 31. Sept. 1.

Yellow-throated Vireo, 18, 19, 27. Sept. 17.

Cardinal, 22.

Bluebird, 21, 22, 27. Sept. 3, 7, 10, 12, 17, 26, 28.

Long-billed Marsh Wren, Sept. 7.

Swamp Sparrow, 15, 16, 18, 21, 23. Sept. 3.

Spotted Sandpiper, 22, 27.

Chickadee, 17, 27, 31. Sept. 12.

Eave Swallow, 17, 19. Sept. 1.

Hermit Thrush, 29. Sept. 7, 9, 10, 12, 15, 16, 24, 29.

Least Flycatcher, 27. Sept. 3, 10.

Purple Martin, 14 to 27, 19, 22, 24, 28. Sept. 7.

Birds seen on the dates after their names:

Alder Flycatcher, 26.
White - crowned Sparrow, Sept. 24, 25, 28.
Nashville Warbler, Sept. 25.
Golden - crowned Kinglet, Sept. 25 to 30.
White - throated Sparrow, Sept. 28, 29, 30.
Hummingbird, 15, 21, 22, 26. Sept. 1, 2, 3, 4, 6, 7, 8, 10, 11.
Red-winged Blackbird, 25.
Vesper Sparrow, 17, 18, 19, 28. Sept. 3.
Red-eyed Vireo, 17, 20, 23. Sept. 2, 17.
Towhee, 17, 20. Sept. 2.
Maryland Yellowthroat, 20, 26. Sept. 2, 4, 5, 6, 11, 16, 17, 20.
Loggerhead Shrike, Sept. 5.
Killdeer, 22. Sept. 6, 16, 20, 21, 22, 24, 26, 27, 29.
Redstart, 29. Sept. 20.
Yellowlegs, 14, 19, 21, 22, 28. Sept. 2, 5, 12 to 17, 19, 21, 23.
Black-billed Cuckoo, 19, 27, 30. Sept. 10, 29.
Tree Swallow, Sept. 1.
Hell Diver, Sept. 8, 21.
Hairy Woodpecker, Sept. 5.
Yellow Palm Warbler, Sept. 15, 29.
Myrtle Warbler, Sept. 25, 29, 30.
Brown Creeper, Sept. 25.
Snowbird, Sept. 26 to 30.
Red-breasted Nuthatch, Sept. 28, 29.

Number of species seen each day:

Aug.	14, 18.	Sept.	7, 27.
"	15, 26.	"	8, 21.
"	16, 27.	"	9, 16.
"	17, 30.	"	10, 22.
"	18, 29.	"	11, 20.
"	19, 31.	"	12, 20.
"	20, 27.	"	13, 12.
"	21, 25.	"	14, 12.
"	22, 32.	"	15, 15.
"	23, 25.	"	16, 13.
"	24, 19.	"	17, 18.
"	25, 25.	"	18, 12.
"	26, 25.	"	19, 16.
"	27, 25.	"	20, 17.
"	28, 23.	"	21, 14.
"	29, 25.	"	22, 17.
"	30, 22.	"	23, 15.
"	31, 22.	"	24, 15.
Sept.	1, 28	"	25, 19.
"	2, 27.	"	26, 12.
"	3, 26.	"	27, 14.
"	4, 20.	"	28, 14.
"	5, 24.	"	29, 16.
"	6, 20.	"	30, 12.

Total number of species seen, 65.

Rocky Mountain Botany.

A General Review.

It is now just forty years since the present writer began his field studies of the vegetation of the Rocky Mountain region, in what was then Colorado Territory. In April, 1870, there were no public centers of botanical study, no libraries or herbaria, no resident students of the Rocky Mountain flora within the whole length and breadth of that land. There did not exist even the beginnings of any such thing as a local handbook of descriptive botany for the region, or for any part of it. To something like a comprehensive help to general plant study there, some approach was made a little later, in the Botany of Clarence King's Expedition, with its several very useful monographic supplements; but this book was not yet extant in 1870; and, until a much later date, the most ample library equipment for a student of Rocky Mountain botany could contain no books more serviceable than the two volumes of the unfinished Flora of North America, by Torrey and Gray, the botanical parts of several Pacific Railway Survey Reports, and certain monographs of western families and genera by Torrey, by Engelmann, and by Asa Gray, including the last named author's list of Colorado plants of Parry, Hall and Harbour, wherein a few new Colorado species had been described.

In this year 1870 it was the opinion of the highest authority that by the copious gatherings of Parry, Hall and Harbour, the botanical field of the Colorado Rocky Mountains had been well night exhausted. I have a letter from Asa Gray, written to me while I was still in Colorado in 1871, which closes with this remark: "I hope you will find some new species; but you will be sharp if you do." Three years later than this, namely in the beginning of 1874, there came forth from the Government printing office in Washington as a part of the U. S. Geological Survey Report, a thick pamphlet entitled, "A Synopsis of the Flora of Colorado." The author of this was Thomas C. Porter. The name of J. M. Coulter held a subordinate place on the title page; but every paragraph of original work was claimed by Professor Porter as his own. To those who knew the man, no question will be raised as to his sole authorship of the book. The work itself was of value to beginners in Colorado botany, notwithstanding that for all species of plants not peculiar to the region, reference was made to Gray's Manual of the eastern botany for the descriptions. To my own library the book was not a very significant addition, for the reason that at this time I had myself done

tenfold more work on Colorado botany than my friend Professor Porter had done. With the exception of eight or ten new species which had been gathered in southwestern parts of the Territory unvisited by me, most of the plants enumerated in the book were more familiar to me than to the author of the book, or to any other, for I had now devoted four years rather continuously to the study of this field, and had detected many plants which had not been found there by any of my more transient predecessors. These results of my researches, asked for by Professor Porter, found special mention by him in his Preface.

During eleven years next succeeding the appearance of this first Colorado Flora, I had traversed much of Colorado, Wyoming, California, Arizona and New Mexico. Within this period I had acquired a fuller knowledge of far western botany than had ever before been gained by an individual botanist; and the abundant new facts gathered, in as far as published at all, had been published in the main by Asa Gray; this also not so much by sending him new types as by indicating the characters of species already long in his possession, but, wrongly placed by him because of his failure to see the characters.

I shall never be chargeable with having been premature in making my beginnings at authorship on Rocky Mountain botany. To the study of this flora and other more or less related floras, to the eastward, westward and southward of it, I had devoted sixteen years; and a very considerable part of the knowledge gained so laboriously and devotedly, I had given to another to publish as his own. I was already 42 years old and more, when, in 1885, I published my own first paragraph of new Colorado botany.

Coetaneously with this little event, there came forth from the press a volume with the large title of a "Manual of Rocky Mountain Botany." Its author, in his Preface, commendably disclaimed any particular knowledge of the region named. Still, as a mere compilation from books and monographs by men accepted as authorities, the work must have subserved some useful purpose in the hands of plant lovers touring in the summer time in Colorado Mountains; people who could not have carried with them so conveniently the volumes of Gray's Synoptical Flora, and Englemann's quarto Monographs. I was located in California when this book appeared, and it found a place on my library shelves. This was a quarter century since; and, though during the whole of this period I have wrought more than any other upon Rocky Mountain botany, I doubt if I have consulted the book a half dozen times. For the real student of that flora there was nothing in it.

From 1885, another twenty years and somewhat more had passed when there was announced "A Flora of Colorado, by P. A. Rydberg;" this in 1896. Those twenty years covered a period of the greatest activity of exploration and research into Rocky Mountain botany. Within those two decades more, and more effective, work had been done in that field than in the hundred years preceeding them. My own contributions in California Academy Bulletins, in the five volumes of my Pittonia, and in earlier volumes of the journal Erythea, which I had established, will be cited henceforward for the greater part of this constructive work; and next after my own, both in point of time, and the amount of work accomplished, are the entensive contributions of Dr. Rydberg, in his "Flora of Montana," and in a long list of able studies published largely in the Bulletin of the Torrey Club. The call upon Dr. Rydberg to prepare a Colorado Botany came from the State itself; and he can not but have set his hand to the task with some enthusiasm; otherwise he could not have fulfilled it so well.

This Colorado Flora of Rydberg I cannot help thinking of as having made possible another book of Rocky Mountain botany, which, only three or four years behind it, has lately appeared under the title of a "New Manual of Botany of the Central Rocky Mountains." The authorship is divided between Professors John M. Coulter and Aven Nelson. It purports to be a new edition of the old compilation of 1885, yet is said to have been written entirely by my friend the Professor at Laramie, Wyoming; and it is about as different from the earlier book as can well be imagined; is even an incomparably more useful book; this notwithstanding that the earlier "Manual" was in a manner faultless, while this later one is full of faults.

However, the only book with which instructively to compare Professor Nelson's work is not the Rocky Mountain Manual of twenty years since, but Rydberg's Flora of Colorado, named above, and almost as recent.

The first of several contrasts that will be noted by one acquainted with the whole field will be in respect to the dimensions of the books; for the Rydbergian volume, embracing probably less than one-third the geographic area of the Nelsonian, and which ought to have been by much the smaller of the two, is manifestly the larger; and this despite the fact that in it there are no diagnoses of the genera or species, whereas in the other both genera and specis are described, and that in no cramped or niggardly manner. But this contrast of dimensions might chance to prove of no great significance. In truth, the paper is thinner in the Nelsonian volume, also the type used is a trifle smaller. Yet again, the Rydbergian page

is both longer and broader. But we shall make a more fair comparison—at least a more significant one—by taking a census of the pages. The volume of the small territory has about 410 pages, that of the thrice larger, about 610. This, in view of the fact that in the book for the one state there are no descriptions, while in that covering almost four states as large, there are full diagnoses, is a contrast almost amazing; for, we who know well how speedily and multifariously environments change throughout the whole Rocky Mountain region, understand well that an honest flora of all Colorado, Wyoming and Montana, plus half of New Mexico and Utah, must embrace, if not twice as many plants as Colorado alone, at the very lowest possible estimate, one-third as many more. At this point we may take the testimony of each author himself as to the phytologic contents of the two fields so vastly unequal in extent. For Colorado alone, Dr. Rydberg enumerates 2,912 species; for the three of four times greater area, Dr. Nelson lists only 2,733 species; admitting, however, as by way of accounting for this astounding discrepancy that, of other —and we add, older and more experienced—authors' species he has reduced 1,788. These large reductions to synonymy include species by even that most conservative of American botanists, Asa Gray; also according to an estimate of my own, somewhat less than 400 species of Dr. Rydberg, whom I hear people speak of as having been Dr. Nelson's botanical father. If so, this will remind us of a common Old World plant which, in mediaeval Latin nomenclature, they called *filius ante patrem*. Such almost wholesale suppression of other men's contributions to Rocky Mountain botany will seem at first thought hard to excuse or condone; perhaps the more difficult after one has noted that the very few Coulterian as well as the multitudinous Nelsonian species are commonly maintained as valid. I doubt very much that any botanical community on either side of the Atlantic will be found to be of the opinion that Dr. Rydberg and I are the reckless species makers, and that Dr. Nelson is the careful, cautious and discrete conservative. I, who have noted the very beginnings of the botanical career of each man now active in North American botany, have no such opinion of my friend in Wyoming, nor, as I said, do I believe it exists anywhere.

Let us look now somewhat more closely into the question; and that by way of considering the membership of some particular genus. It may as well be *Senecio*, for that is a very ample one, and is abundantly represented in the Rocky Mountains. Going back a quarter-century into the past, and to a time when only one name of botanist now active in Rocky Mountain botany had yet been heard, we shall find that we

had then one standard book in which *Senico* was treated of and that for the whole of North America, north of Mexico. Gray's Synoptical Flora has of this genus, for the whole country only about fifty species. Of this number, by the way, one-tenth are therein credited to the present writer. They constitute the sum of all the senecios which, up to 1884, I had published; and Dr. Gray, above all American botanists, abhorrent of imaginary or feeble species, questioned the validity of none of them.

Coming down now from 1884 to 1906, a period of 22 years, Dr. Rydberg in his Colorado book, has 66 species of *Senecio*, a dozen or fifteen more than Gray had admitted for all North America. I note also here that not barely one-tenth but one-third of the Colorado senecios are mine according to Rydberg. But now, to the whole of Colorado, plus almost or quite thrice as much territory adjoining it, Dr. Nelson accords only about 40 species to the genus: two-thirds as many only, for the trebly extended area as for Colorado alone; and in the process of reduction of them for the Rocky Mountain Manual, some 15 of my senecios have fallen decapitate, and some 25 of those of my colleague Rydberg. The *Senecio* genus may be a not unfair example to have chosen by which to demonstrate how this book for almost the whole Rocky Mountains should not have been made a smaller volume than the one embracing Colorado only. Other large genera in families in which the bulk of later work has been done either by Dr. Rydberg or by myself, or by both, would probably yield similar statistics. Also, as somewhat in criticism of the able author of the Colorado Flora, I am bound to note here, what I have observed through many years, that he is too impatient, apparently, of studying descriptions. On this account he has published over again, as new, a rather long list of things which I had clearly published at earlier dates. Not a few of Dr. Nelson's reductions of Rydbergian species consist in a mere showing that I had published the same plant before. In *Senecio* one such case has remained undetected by the author of the later Manual. Both he and Rydberg have a *Senecio altus* Rydb. It is precisely the same as my *S. sphaerocephalus*, which was published four years earlier.

While we have still in mind this matter of the suppression of species for which the book is so conspicuous, let us not fail to note one circumstance that may seem to ameliorate the situation, or at least to mitigate in some degree the offense against men as able and as conscientious as any who have worked in this field. The writer of this Manual, quite unlike some of his contemporary authors, is careful to cite the place of the publication of such species as he suppresses. Really

this is the least that can be done in the spirit of justice to science and of honest dealing with one's fellow botanists. In this way it is made easy for any student to consult the descriptions of hypothecated or rejected species, and so he is helped to the means to form his own judgment about them. And the commendability of these bibliographic notes or citations is all then more manifest in view of the certainty that, occupying no inconsiderable amount of space, the cost of printing the book has been increased, and the profits from the copyright have been in the same ratio diminished.

Men have already criticized, and will further complain of, the unevennesses and inconsistencies of this book; the development of some of the plant families being according to the latest and best results of careful research, while other groups are left in a sort of archaic *statu quo*. In the family of the borraginaceae, for example, there was a genus called by a barbarous name, *Krynitzkia,* and credited with 11 species, this according to the old Manual, which same group in the new consists of the three genera *Allocarya, Cryptantha* and *Oreocarya,* with an aggregate of 33 species. By the same criteria, that is, by characters, both generic and specific that are of equal value, the genus *Polygonum* should have been resolved into the four genera of *Polygonum, Persicaria, Bistorta* and *Bilderdykia,* with increase of species nearly in proportion; yet the *Polygonum* of the new Manual differs from that of the old one in no respect except by the increase of the species number of 16 in the earlier to 28 in the later edition. And while such perfectly natural and marked genera as *Persicaria* and the others are ignored, such comparatively feeble generic proposition as *Anogra, Pachylophus, Lavauxia, Galpinsia* and *Sphaerostigma,* artificial and questionable segregates from the old *Oenothera* are sustained in the new book; and over against this rather forced segregation in the Onagraceae, there stands as of old the archaic and impossible genus *Rhus* of Linnaeus in the new volume, quite as in the old. Nevertheless, let no one who complains of these inequalities in the new Rocky Mountain Manual attribute them to that work as peculiarities. There are other books of the kind, too many of them, that have the same fault.

We have now, and almost all at once, also after long waiting, two highly serviceable octavos of Rocky Mountain systematic botany. We have rejoiced and shall rejoice in both of them. Moreover, we shall be glad again, and more glad, perhaps, when Dr. Rydberg's long hoped for volume—or volumes—on the same great flora shall have appeared.

EDWARD L. GREENE.

Washington, D. C.

Banister's Catalogue of Virginia Plants.

Jacques Philippe Cornut's Historia Plantarum Canadensium, published in Paris in 1635, is undoubtedly one of the earliest records of North American plants. This work contains descriptions and illustrations of many species, the geographical range of which include not only New France, but also New England and the territory southward to Virginia, and the Carolinas. We could mention several species which are common or at least not rare within the borders of Maryland and Virginia, but will content ourselves with two striking examples, namely: "Filix baccifera" (= *Cystopteris bulbifera* L.) and the strikingly beautiful "Adiantum americanum" (= *Adiantum pedatum* L.) the latter being one of our characteristic ferns of low, deciduous woods.

In 1640, Parkinson published his Theatrum Botanicum, wherein he records many plants from Virginia. We may cite again Adianthum fruticosum americanum. The weird, but beautiful Juniperus virginiana, the characteristic ornament of the lower Potomac region and elsewhere is mentioned in this work. Virginian plants are mentioned in many other works, but the earliest *list* of plants from our region is contained in Ray's Historia Plantarum (vol. 2; pp. 1926–1928, 1688). This list is known as Banister's Catalogue and is of special interest to those who devote themselves to the Botany of the middle Atlantic States.

Of Banister we know very little except that he lived and labored in Virginia. Ray pays him a tribute in his Historia Plantarum (vol. 3; IV, 1704); "D. Joannes Banister primi subsellii Botanicus, Vir magni nominis & famae, quem Historiae hujus initio laudavimus. Virginiae ubi per plures annos sedem fixit, plantas mira industria indagavit & descripsit, rarioresque propria manu ad vivum delineavit; infelici tandem & deplorando casu antequam Historiam Naturalem istius provinciae, quam prae manibus habuit, perfecerat, dum rupes incautius scanderet, rebus humanis exemptus est."

A brief sketch of Banister's life was given also by Pulteney (Hist. & Biogr. Sketch 2:55-57, 1790).

In examining the catalogue anyone who is somewhat familiar with the plants of our region would at once recognize many of the species. The task of identifying a number of them, however,

would be a difficult one, for it would require a careful study of the prominent authors of that period. The method of description of two centuries ago presupposes an intimate knowledge of the older masters, and their terminology. This is readily seen if we examine Banister's second species: *Alsine Becabungae folio.* The expression serves both as a name and as a description, wherein a knowledge of another plant, *Veronica beccabunga*, is prerequisite.

Among the species which are readily recognized, we may mention a few; *Castanea pumila racemoso fructu parvo in singulis capsulis echinatis unico.* The Chinquapin, is our common *Castanea pumila; Clematis purpurea repens petalis florum coriaceis* is *Clematis viorna* L., while *Clematis erecta, humilis non ramosa, foliis subrotundis, flore unico ochroleuco* is *Clematis ochroleuca.*

Dens caninus flore luteo which is blooming now in our beautiful woods, is none other than the dog's tooth violet—*Erythronium americanum.* The old name of this plant has evidently survived in popular nomenclature.

Filix mas rachi seu nervo medio alato is evidently *Phegopteris hexagonoptera* and the very interesting little walking fern, *Camptosorus rhizophyllus* cannot be disguised under its Banisterian name—*Phyllitis parva saxatilis per summitates folii prolifera.*

Banister mentions all of our species of Araceae except the very few rare forms.

The genus Quercus is interesting. Here we find a clear case of popular names translated into Latin: "*Quercus variae species*, 1. *Pumila*, 2. *Alba*, 3. *Rubra*, 4. *Hispanica*, 5. *Castaneae folio*, 6. *Lini aut Salicis foliis*, 7. *Fruticosa*."

Ulmus fructu Lupulino is our common Iron-wood—*Ostrya virginiana.*

In the December number of *Torreya* * Dr. Barnhart, discussing "Some American Botanists of Former Days," reproduces for the "first page of Banister's Catalogue" what really is the title page of the second volume of the "Flora Virginica" of Gronovius. That the reproduction in *Torreya* is not Banister's first page seems self-evident, aud we wonder how such a mistake was allowed in print. We herewith reproduce part of the real "first page."

* *Torreya*, Vol. 9, No. 12, p. 243.

1928 **HISTORIA PLANTARUM.**

E Catalogo huc tranſmiſſo *Anno* 1680. quem compoſuit eruditiſſimus Vir & conſummatiſſimus Botanicus D. *Johannes Baniſter* Plantarum a ſeipſo in Virginia obſervatarum.

A.

ALſine Spergula latifolia reptans

· Becabungæ folio.

Althæa lutea Pimpinellæ majoris folio, floribus parvis, ſeminibus roſtratis. Folia hujus plantæ pediculis inſident.

Althæa magna Aceris folio, cortice Cannabino, floribus parvis ſemina rotatim in ſummitate caulium, ſingula ſingulis cuticulis roſtratis cooperta ferens.

Althæa magna quinquecapſularis, cortice Cannabino, foliis integris ſubtus albicantibus, floribus magnis ex fundo ſaturatè rubro albis.

Alth. magna quinquecapſularis, cortice Cannabino, foliis Malvarum modo diviſis, ſubtus viridibus.

Ambroſia inodora foliis non diviſis.

gigantea inodora foliis aſperis trifidis.

Anchuſa lutea, minor, quam Indi Paccoon vocant ſeipſos ea pingentes.

Anemone latifolia ſylveſtris alba.

Apocynum erectum non ramoſum folio ſubrotundo, umbellis florum rubris.

Apoc. erect. non ramoſ. latiore folio, umbellis florum albicantibus

Apoc. erect. minus. umbellâ florum candida

Conyza cœrulea acris Americana

Cucumis fructu minimo viridi, ad maturitatem perducto nigricante. Fructus Bryoniæ albæ bacca non multo major eſt, cujus primo aſpectu ſpeciem eſſe putaveram

D.

Dens caninus flore luteo.

Digitalis flore pallido tranſparenti, foliis & caule molli hirſutie imbutis.

Digit: rubra minor, labiis florum patulis, foliis parvis anguſtis.

Digit. lutea elatior Jaceæ nigræ foliis.

lutea altera, foliis tenuius diſſectis thecis florum foliaceis.

parva comis coccineis.

E

Eryngium campeſtre Yuccæ foliis, ſpinis tenellis hinc inde marginibus appoſitis.

Euonymus capſulis eleganter bullatis

F.

Filix mas foliis integris auriculatis.

mas rachi ſeu nervo medio alato

fœmina foliis per margines pulverulentis

PLATE XIV PART OF THE FIRST PAGE OF BANISTER'S CATALOGUE

Fac-simile from "Historia Plantarum" by John Ray, 1688

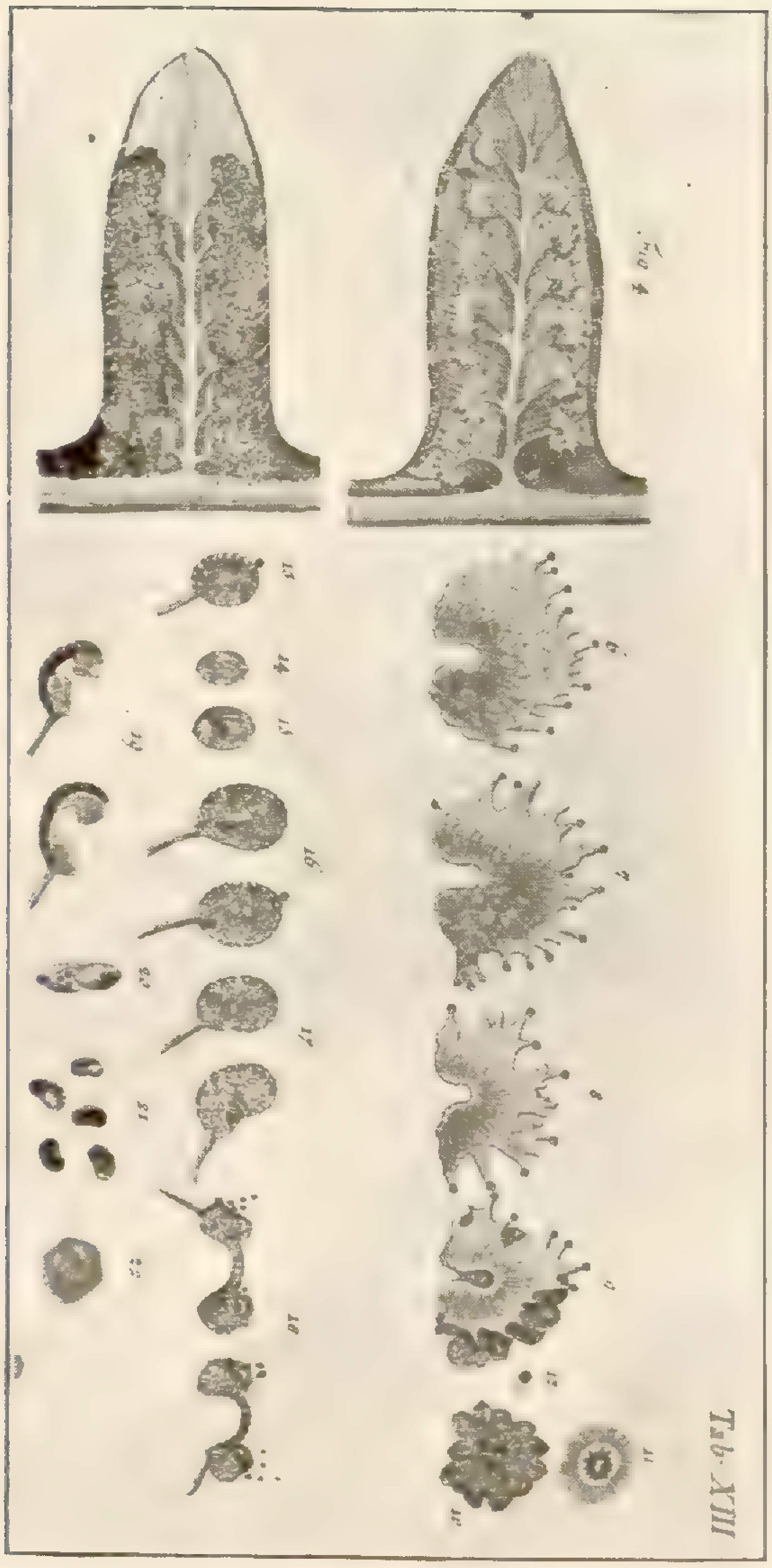

PLATE XVI. NIEUWLAND ON DRYOPTERIS.

Photo by Staples

Page 224

Photo by Staples PLATE XVII. NIEUWLAND ON DRYOPTERIS. Page 221

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Early Spring Plants of Central North Dakota.

J. LUNELL.

It would be rather deceptive to determine the arrival of spring in North Dakota by the almanac. Sometimes it commences in March, but as a rule not until April. It does not set in promptly, as in the far north, where the Snowdrop, *Galanthus nivalis* springs up well-nigh from the bosom of a snow drift, and the *Narcissus*, *Crocus*, *Tulipa* and *Hyacinthus* follow just as soon as the ground is bare. On the contrary, Nature awakens very slowly here, and its progress is lingering, and it is timid and careful, afraid of being taken by surprise, the weather becomes slowly and imperceptibly warmer, and the first spring flower, *Pulsatilla hirsutissima*, dares at last to burst forth, after two weeks of hesitation. Invariably it receives its punishment, as the frost reaps millions of these flowers every spring. But another succession of flowers appears, the plumose styles and the leaves grow out, and late flowers are borne contemporaneously with the fully developed leaves in June and even July. The common name of this plant here is *Crocus*, probably because its sepals have the same size and shape of this offspring of the celebrated family *Iridaceae*, because both are children of the earliest spring, and because this, as we have no real *Crocus*, is the best "Crocus" available. Not even *Sanguinaria canadensis*, a plant growing in the extreme eastern part of the state, reaches this territory. The first day I found the *Pulsatilla* this year was on the 24th of March.

After this day comes a period of slow and tedious expectation, until by April 10th *Ranunculus ovalis* enters the stage, now just as tiny and tender as it is rank and exuberant four weeks later. *Acer fraxinifolium*, *Populus balsamifera candicans*, *deltoides* and *tremuloides*, *Ulmus fulva* and *americana* and *Celtis crassifolia* bring forth their flowers in advance of the leaves by this time, followed two weeks later by *Prunus*

* June 15, 1910.—Pages 197 to 228.

americana, and still two or three weeks later by the aments of *Salix Bebbiana, candida, cordata, discolor* and *petiolaris*, the leaves of all of these appearing later than the flowers.

The herb coming next to *Ranunculus ovalis* is *Viola Lunellii* Greene, peeping out on April 18th, and two or three days later *Potentilla concinna* and *Lomatium orientale* never fail to present themselves, the latter being synchronous with *Cymopterus acaulis* and *Lomatium villosum* in the western part of the state. Now enter in quick succession *Viola Nuttallii* on the hill tops and *V. vallicola* further down the hill sides, and *V. Rydbergii* is the first blossom of the year penetrating the deep shade beneath the trees of the woods. Somewhat later than these *Viola anisopetala* Greene, and *V. pedatifida* are due. At this time *Mertensia foliosa* and further west *M. coronata* (or species very much resembling these natives of western Wyoming) enhance the beauty of the prairie.

An excursion on the 23d of April resulted in the following finds: *Phlox Hoodii, Lesquerella Lunellii* (maybe the most lovely looking plant of the genus, and at this time west of the divide replaced with *L. montana*), *Orophaca caespitosa* and *Carex filifolia*, all of these plants preferring the summits or the slopes of the hills, while *Antennaria campestris* loves the damp meadows, *Plantago eriopoda* chooses the whitish, alkaline low-land, and the holy grass, *Savastana odorata*, as the first-born of its family, gives a faint idea how magnificent the prairie will look when it becomes green at last.

Another excursion was made to Butte, on the 30th of April, which added the following plants to the spring flora: *Amelanchier alnifolia* in blossom and the just opened young leaves. *Sieversia ciliata, Comandra pallida, Androsace puberulenta* (in some other localities east and west of here replaced by *A. occidentalis*). *Nothocalais cuspidata, Thalictrum thyrsoideum* Greene, *Astragalus crassicarpus, Fragaria glauca* and *Aragallus dispar*. The last named plant is local for Butte, and transforms this place on the high hills into a veritable paradise during those ten days when it is blossoming. I have counted on its flowers a variation of sixteen different shades of gorgeous colors, from white, cream color, ochroleucous, light and dark blue, to light and dark rose purple, surpassing in their diversity all other plants of this state and probably of many other countries.

Of introduced plants these pariahs of the vegetable kingdom always unwelcome, undesirable hangers-on, nuisances in the path of civilization, weeds in the fields and around the railway stations, along the streets and in the yards of our cities, where they supplant the native herbs, as weeds often becoming

a still higher grade of nuisances than they are in their native countries, of so many different kinds later in the season, we have only one representative in the early spring, the common Dandelion, *Taraxacum officinale*. This plant seems to have decided to conquer the earth, not even respecting the virgin prairie, where it often is smothering most other forms of plant life. Only a few years have passed since its first invasion, but we all understand that it came here to stay permanently.

This being an unusually early spring, with its vegetation three or four weeks in advance of what is produced in an average spring season, a continued chronological enumeration of plants would drift us into the flora of late spring or early summer. As this is quite a complete record of our early spring flora, it proves certainly beyond doubt that this flora is rather deficient in species numerically, and the flowering time for this flora is very variable for different years. However, such disturbances disappear gradually as the season advances, and the equilibrium is restored altogether at or maybe before the end of June. A plant like *Lilium umbellatum*, due on July 1st, knows and obeys this law, and will always arrive on time just when it is due.

Leeds, North Dakota.

Notes on the Seedlings of Bloodroot.

J. A. NIEUWLAND.

Having been fortunate during the season just past in securing typical stages of development of seedlings, I proceeded to examine these systematically with a view of obtaining results worthy of record. A more thorough anatomical investigation must, however, be reserved for future study.

The plants were specimens of the common Bloodroot of our middle western prairie region, which seem to be *Sanguinaria mesochora*, Greene,* or *Sanguinaria canadensis*, Linn., and of the authors in part. This species proposed by Dr. E. L. Greene appears to be somewhat different from the plants of the middle Atlantic States, and of New England and Northern Canada. The flowers of the mature plants, around which the seedlings were found, are comparatively small and almost invariably quadrate, of four large, broad outer petals and four smaller, shorter, and narrower inner ones. The flower has a

* Greene, E. L. Pittonia, Vol. V, p. 306-308.

distinct squarish appearance when full blown. Only once have six petalled flowers been found out of hundreds examined in the last six years, and once too was a four petalled specimen obtained, the petals of the latter being the outer larger ones. Nine petals were once found, the ninth so placed as hardly to interfere with the quadrate appearance of the corolla. These three cases being so rare, I have considered them as teratological.

The foliage of the plants is quite large in fruit, the single leaf in anthesis being about the length of the scape whose flower is enclosed by it. The petiole lengthens out in fruit, and should the latter fail to develop, or be removed the leaf-blade shows a special tendency to increase in size. It is on mature plants almost always seven lobed, round, not broader than long, the apical lobe smallest and the basal ones largest, the whole leaf often six inches in diameter. The relations of the various species of Bloodroot proposed by the above-mentioned author can best be understood from the original publication.*

The Bloodroots are distinctly and exclusively American, and though known before the time of Dillenius,† he seems to be the first botanist of note that recognized the plants as of distinct generic standing. He called the several kinds that he recognized by the name *Sanguinaria*. This name had, however, been used by Pliny and the older herbalists of the seventeenth century for a grass, and so on the basis of strict absolute priority, the name would, after all, be a homonym for Bloodroot. For this reason in 1763, and before 1753 as a "starting point" for botanical nomenclature was dreamed of, Adanson, gave the genus the name *Belharnosia*. The name, strictly speaking valid for the plant, was not taken up, and many do not know that it was given, or why. Bubani‡ in his Flora Pyrenaea restores the Plinian name *Sanguinaria* to our so-called *Digitaria*, and accepts Adanson's name for the Bloodroot.

Linnaeus in his Species Plantarum accepted the Dillenian name, but reduced his several species to one under the Trivial name *Sanguinaria canadensis*, content to designate the others as varieties. This opinion was held up to a few years ago, and the genus was considered as monotypic.

Dillenius** seems to quote Morin as responsible for the

* loc. cit.

† Dillenius, J. Hortus Elthamensis, Vol. 2, p. 21.

‡ Bubani, P., Flora Pyrenaea, (1901). Vol. 4. p. 256.

** The Bloodroots illustrated by Dillenius were of course eastern American specimens and all show the leaves shorter than the flowers in full bloom.

name *Sanguinaria*. The plant was first recorded in the pioneer work on American botany, *Historia Plantarum Canadensium*, of J. P. Cornut, in 1635. He called the plant *Chelidonium americanum flore albo*. John Parkinson†† refers to the plant as *Ranunculus Virginiensis albus*. Robert Morison§§ accepts essentially Cornut's name, *Chelidonium maximum canadense acaulon*. Plunkenet§ recognizing its affinity to the Poppies, called it *Papaver corniculatum, seu Chelidonium humile cauliculo nudo, flore albo stellato*. Dillenius says that the natives called the plant *Pocan*, a name also applied to *Phytolacca* or Pokeweed, in the American colonies.

The seeds of Bloodroot appear to germinate in the fall as well as early spring, especially when warm rains occur late in the season. Several or a dozen plants may usually be found near the older plants while these latter are still in bloom. The seeds ripen in summer early. The seedlings vary somewhat in appearance, size, and development depending upon the condition in which thy germinate, especially nutriment, soil, shade. Injury to the first leaves greatly retards the plants, and two year old plants may be found that are smaller than the plants of the season. The plants, however, immediately begin to replace injured or aborted leaves, and though they seldom have more than one leaf at a time at the end of the rhizome, seedlings with two have been found. Old retarded plants can be easily recognized from seedlings by the presence of several scales at the apex of the rhizome. Replacing of injured or aborted leaves may take place any time if the season is not too far advanced.

Plants germinating in drier sunny places have shorter petioles to their leaves than those growing in shady places covered with the dry leaf mould of last fall. This difference is evident from a comparison of Plates 1 and 2, the former growing in more sun-exposed places and clayey soil. The plants in each are arranged from left to right in order of age. In the second row of Plate 1 is a two leaved specimen and next to it a seedling that had three cotyledons.

The cotyledons of Bloodroot are obovate, about 5 to 8 mm. long and about 3-4 mm. wide, tapering to a short channelled petiole. They are flesh-colored to light orange, chlorophylless and hypogeal. The color is due to the presence of several laticiferous ducts around each of the five to seven primitive wood bundles which branch out palmately from the petiole, and come together again at the rounded or obtuse apex.

†† Parkinson, J., Theatrum Botanicum, (1640). p. 327.

§§ Morison, R. Historia Plantarum, (1680). Part I, p. 257.

§ Plukenet, L. Almagestum Botanicum, (1696). p. 280.

The seeds are exalbuminous containing a large raphe along one side; they are black and smooth. After germination the empty seedcoat is found indifferently on the ends of the cotyledons, or on the apex of the first leaf. Often it falls off in the process of germination. When three cotyledons are present, their shape does not vary, but they are smaller than the usual two. The cotyledons wither in a few weeks.

The first leaf is palmately veined, orbicular in outline, cordate at the base devoid of any lobes, but with just the indication of an obtuse prominence at the apex. As the succeeding leaves appear the second year a small lobe develops at the apex. Even the first leaves may when vigorous or when older become slightly wavy margined. Variations in the length of the petiole of the leaf, and its replacement have already been referred to.

The most interesting part of the Bloodroot seedling is the hypocotyl. When just come out of the seed this organ does not seem to differ from that of ordinary seedlings where it is present. It contains a four rayed radial wood bundle as in the typical root. The bundle is surrounded by an endodermis and within this the pericycle. Secondary development begins in a few days and after the first leaf has reached the light and expanded, the xylem portion of the bundle increases rapidly in area. Secondary tissue as pith appears in the centre. The hypocotyl at first swells out greatly due to rapid growth and multiplication of the cells in the cortex; after a week or two this outer growth slackens and the subsequent thickening is mostly due to the enlargement of the pith. The mestome strands in the older rhizome which is developed from the hypocotyl, do not increase in great numbers, but soon are scattered in the circle of the cambium. The interfascicular cambium is well developed.

Lubbock* in his work on seedlings refers to somewhat similar enlargements of the hypocotyl of seedlings. The first case is that of our common radish, *Raphanus sativus*, Linn., the thickened edible "root" of which is developed from the hypocotyl.† The root stock of *Cyclamen persicum*, Mill, is likewise developed from the hypocotyl.‡ In *Testudinaria elephantopes* Burch.|| a similar embryonic thickening is recorded. This plant seedling seems to be entirely rootless for a time. The upright rootstock of Cyclamen, the thickened primary "root" of the radish, and the rhizome of Bloodroot are then developed

* Lubbock, J. A Contribution to Our Knowledge of Seedlings, 2 vols. 1892.

† Ibidem. Vol. I, p. 178.

‡ Ibidem. Vol. II, p. 184.

|| Ibidem. Vol. II, p. 576.

from the embryonic organ, the hypocotyl. In the case of the Bloodroot the hypocotyl soon twists around horizontally and becomes an elongated creeping structure, the rhizome. As it grows new leaves and scales from year to year, buds are left behind and these account for the branching of the older rhizomes. The twisting around of the hypocotyl may be noticeable within the first week of growth.

The primary root, or the continuation of the underground hypocotyl does not seem to increase in thickness at all. As the hypocotyl assumes its horizontal position, the primary root and its branches become soon aborted and wither away. This twisting and also the gradual disappearance of the first root is strikingly evident in the series of plants in the accompanying illustrations. Secondary adventitious roots soon develop from the lower side of the horizontal hypocotyl now become the new rhizome. All the roots of Bloodroot after the second year are undoubtedly adventitious. Lubbock reports such adventitious roots on the seedlings of *Begonia villosa*, Lindl.§ at an early stage of growth.

Examination of plants older than two years has not been systematically made, so that there is no direct evidence as to the manner in which the older rhizomes branch. It is not even known to us whether the buds may not be adventitious, though this is not likely. In any case, the lengthening out of the rhizomes is a very slow process under ordinary circumstances and extended and continued systematic study of older plants is necessary. The size and number of the lobes of the leaf seem to have some connection with the age of the plants and this fact too has not been investigated.

Conclusions:

1. The cotyledons and hypocotyl of our form of Bloodroot, *Sanguinaria mesochora*, Greene, are hypogeal and chlorophylless.
2. The rhizome or rootstock of the plant is developed from the horizontally twisting hypocotyl, which increases in thickness, at first by enlargement in the cortical area, and later in the center or pith of the single radial bundle.
3. The primary root soon dies, at least before the second year, and all the roots of older plants are adventitious.

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§ Ibidem. Vol. II, p. 2.

New Plants from North Dakota.

J. LUNELL.

The native species representing the multiform Spurge family in North Dakota are, according to my experience, surprisingly few. I never found them on the virgin, undisturbed prairie, but any kind of injury to the ground enables them to germinate. Their minute description is as follows:

Chamaesyce aequata sp. nov.

Planta annua, obscure viridis, ex superiore radice 2-4 ramos crassos et tot graciles, sicut flabellum irradiantes, emittens; rami ipsi pluries furcati et profuse crescentes, humi prostrati, saepe 3 dm. diametro. Caulis teres, vivide et obscure ruber. Herba tota glabra est. Folia distincte petiolata, opposita, 5-17 mm. longa, spatulata vel oblonga vel obovata, ad basim angustata, obliqua, saepe falcata, crenulate-serrulata de superiore parte marginis magis curvatae usque per totam marginem minus curvatam, vel non raro per totam circumferentiam haud indentata. Apex obtusus, rotundatus (numquam truncatus vel retusus). Folia saepe zonam rubram latam in medio habent et marginibus vivide colorata sunt. Involucrum triangulatis lobis et subulatis. Semina fusca, quadrangulata, angulis eminentibus, inter angulos conspicue rugosa, et inter rugas depressa.

Annual, dark green, from a point immediately above the upper end of the root sending out 2-4 thick branches and as many slender branches, radiating not unlike a fan, the branches themselves branching out dichotomously and growing profusely, prostrate on the ground, often reaching 3 dm. in diameter. The stems are terete and bright red; glabrous as is the whole plant. Leaves distinctly petioled, opposite, 5-17 mm. long, spatulate or oblong or obovate, narrowed at the base, the outline more curved on one side of the median line than on the other, the less curved line often approaching the straight line or the inward bent (then making the whole outline falcate), crenulate serrulate from the upper third of the more curved line along the whole of the less curved line, the indentation quite often failing (the margin seemingly being obliterated by age), thus leaving the whole margin entire or nearly so. The apex is obtuse, rounded (never truncate or retuse). The leaves often present a broad, red belt along part of the median nerve and a bright coloration along their margins. The lobes of the involucre triangular and subulate. The

dark sage-colored seeds quadrangular with prominent angles, the slightly ovate outline approaching the cylindrical form, or with an unequal contour, presenting the straight line on one side and the curve of the ovate line on the opposite, the space between the angles conspicuously rugose and depressed between the rugae.

The plant grows where the ground is level, and develops its fullest beauty where no intruding plants share with it the space needed for its entire expansion.

A species that may be apt to be confounded with this is *C. rugulosa* (Engelm.) Rydb., with its thickly matted growth and leaves toothed along the whole of the less curved side, but its seeds are turgid and very finely rugulose, with deep and irregular pits, and the apex of the leaf is retuse (vide Pttonia II, plate 1). *C. serpyllifolia* (Pers.) Small, differs in having oval, retuse leaves, crenulate at the apex, is procumbent (Persoon. Synopsis Platarum, Vol. II, p. 14]1807[, and has an angled, in the type almost winged stem (vide, Pittonia, l. c.). *C. neo-mexicana* (Greene) is erect, with branches acutely angled, with elongated, sharply pointed seeds, the two ventral facets being concave, and the lobes of the involucre entire or 2-3-cleft. *C. consanguinea* (Engelm.) is rather erect, the apices of the leaves are obtuse and sharply serrate, the lobes of the involucres are lacerate, the seeds are quite dark, rather ovate and blunt on the angles, and the stems and leaves have a more or less red coloration. *C. glyptosperma* (Engelm.) Small, is erect spreading, has linear-oblong, usually falcate and toward the apex slightly serrulate leaves, and quadrangular seeds with 5 or 6 sharp transverse wrinkles and no pitting between these.

The natural disposition of the plant is to spread prostrate upon the ground, but even the least obstacle in its way prevents it from coming there. In this respect it is unlike most other creeping plants, who work their way easily around or between the obstructions. Certain natural conditions force the plant to take the ascending course, and it then appears as the following variety:

C. aequata var. claudicans nov. var.

Ascending, freely branching; the branches are drooping, more or less. It grows on level ground, roadsides, etc. There is something in the way, as for example one or two stems of grass or other plants, a dead leaf, etc., preventing it from spreading over the ground and on account of its aversion to "crookedness," it is forced to grow in a direction diametrically contrary to its native impulse. But it drops its branches longingly toward the ground which they can never reach. This

variety, having to accept conditions that are opposed to its natural tendencies, becomes more or less checked in its growth thereby, but it is no such restraint to the type which attains a size widely surpassing it.

Chamaesyce erecta sp. nov.

Planta annua, viridescens, glabra, erecta, 1-2 dm. alta, furcata, ramos bifurcatione productos etiam aetate breves et plerumque simplices praebens nec raro duos prope aequales ramos e basi emittens. Caules teretes, virides, vel rubescentes. Folia breviter petiolata, ½-1½ cm. longa, spatulata vel obovata, basi obliqua, serrulata de dimidia parte superiore marginis brevioris usque per totam marginem longiorem viridescentia, vel rubescentia, numquam medio rubro-maculata, apice obtusa et rotunda. Semina angulis eminentibus ornata, vel tuberculata vel rugosa, inter tubercula vel rugas haud vel leviter foveolata.

Annual, light green, glabrous, erect, 1-2 dm. high, dichotomously branched, but leaving the branches (even at the end of the season) short and usually simple, or sometimes forking out into two equal main branches from the base. Stems terete, green or light red. Leaves short-petioled, ½-1½ cm. long, spatulate or obovate, oblique at the base, serrulate from the upper half of the shorter side down the whole length of the longer side, light green or light red, never with any red blotch in the median line, apex obtuse, round. Seeds with prominent angles, rugose or tuberculate, with shallow or no impressions between the rugae or tubercles.

It differs from the other erect species of this group, *C. neomexicana* (Greene) and *C. consanguinea* (Engelm.), chiefly by the extended indentation of its leaves, and by other characters mentioned above.

The type locality for these spurges is Leeds, N. Dak., where the first named species is common and the other is sparingly found during the months of July and August. The extension of their territories is unknown to me.

Ranunculus eremogenes Greene var. **Longissimus** var. nov.

Rooting from the nodes with long slender fibres. Stem 8 dm. long; to this length has to be added that lowest unmeasured part of the plant which I was unable to secure from the bottom of the creek where it was growing. The lower leaves very long-petioled (1.5-4.5 dm.). Collected on June 27, 1907, in running water at Leeds, North Dakota.

Senecio Purshianus Nutt. var. **viridescens** var. nov.

This plant differs from the main form in not being constantly white-tomentose, as it becomes gradually greener the more it approaches the time of maturity; in addition, its texture is very soft and herbaceous. It grows in places thoroughly exposed to the sun, preferably high hills. Its flowering time is June, and it is common in central North Dakota.

Some time ago I submitted this variety to Dr. E. L. Greene, asking him to describe it for publication. He expressed his opinion of it in a letter to me, but did not promise to publish it.. In introducing it the golden rule of giving every one his due justifies and commands my acknowledgement of this indebtedness to Dr. Greene.

Corisperm simplicissimum nov. sp.

Planta annua, gracilis, erecta, simplex usque ad inflorescentiam, parte media e tribus valde foliosa, foliis partis inferioris e tribus probabiliter pallescentibus et caducis. Planta tota, imprimis pars ejusdem superior, pubescens etiam aetate, circa 3 dm. alta altiorve, in inflorescentiam multiplicem terminans, unius spicae longae terminalis, et 1-7 spicarum breviter pedunculatarum, vel aliquando subsessilium, angustartum, divergentium, in supremis foliis axilarium. Folia anguste linearia, cuspidata, 2-4 cm. longa, 1 mm. lata vel minus, pubescentia. Bracteae 2-12 mm. longae, 1-1.2 mm. latae, subulatae, margine scariosae, tam latae vel latiores quam utriculum. terminalis 3-7 cm. longa et iis minus angustata. Bracteae per terminalis 3-7 cm. longa et iis minus angustatae. Bracteae per totam inflorescentiam plus minusve densae. Achenia alata singulis vel ambobus lateribus, 2.5 mm. longa, 1 mm. lata ovalia et bractea subtendente cooperta.

Plant annual, slender, erect, simple up to the inflorescence, quite leafy on the middle third, the leaves of the lower third probably fading and dropping earlier in the season. The whole plant, especially in its upper part is pubescent, even in age, and about 3 dm. tall, or taller. Leaves narrowly linear, cuspidate, 2-4 cm. long, 1 mm. wide or less, pubescent. Bracts 2-12 mm. long, 1-1.2 mm. broad, awlshaped, scarious-margined, all as wide or wider than the utricle. The inflorescence is composed of one long spike on top, and 1-7 short-peduncled or sometimes subsessile narrow, divergent spikes in the axils of the upper leaves.

The lateral spikes are 1-2.5 cm. long, narrow, and the terminal spike is 3-7 cm. long, not quite as narrow. All the bracts in the spikes are more or less loosely crowded. Fruits wing-

margined on one or both sides, 2.5 cm. long, 1 mm. broad, ovoid, all covered by the subtending bract.

The predominant feature of this species is its peculiar aspect, the stem being simple throughout to the top with its short peduncled spikes in the upper axils. Its nearest relative, *C. nitidum* Kit., is bushy-branched throughout; its leaves are narrowly linear and seldom more than 2 cm. long; its bracts are not imbricated and are narrower than the utricle, which is 2 mm. long and 1 mm. wide and winged, and the plant is almost glabrous.

C. hyssopifolium L. is profusely branched throughout, its leaves up to 6 cm. long and 4 mm. wide: its bracts are imbricated and its utricle is 3.5-5 mm. long, winged.

I have made out the characters of both of these species from European specimens in my herbarium. All the three aforesaid species are floriferous at the top only. Four other North American species belonging to the west, differ in being floriferous nearly to the base, and divaricately branched below. Two of these, moreover, have a wingless utricle.

The type specimen of *C. simplicissimum* is registered as No. 112 in my private herbarium. The plant was collected by me Aug. 26, 1890, on the shore of a lake several miles southeast of Barton, Pierce Co., North Dakota, as yet the only locality from which it is known to me.

Leeds, North Dakota.

The Laboratory Aquarium.*

J. A. NIEUWLAND.

The term aquarium in its broadest sense may be said to mean any vessel or receptacle for the development of aquatic life. It is most commonly applied to a tank or vessel for keeping the larger aquatic animals. In the latter sense very little reference will be made to the word in this discussion. Most of us may be best acquainted with the term as used for something to keep or domesticate fish and fishlike animals mostly for pleasure. I shall discuss the subject leaving out entirely this interpretation of the word, and confine myself entirely to the laboratory plant aquarium. However, much may have been

*Paper read at the meeting of the Indiana Science and Mathematics Teachers, Richmond, Ind., March 5, 1910.

written on animal aquaria, the literature on growth of plants, — and I refer especially to the microscopic forms,— is indeed meagre. The subject is, however, not without the greatest interest, especially to teachers in high schools and colleges, where competent laboratory work is done. No one will question the desirability of having live plant material for study, and pickled forms are used only when no other is available. Many of the lower forms of plants and animals can only be studied at their best in the motile live stage, and the reason students often carry away from the laboratory false notions is because the living moving plant is seldom seen or at least not as often as might be if the teacher realized that with a little extra effort, a marvelous interest could be stimulated in the student, with living plants. Much trouble is anticipated by the teacher in getting live specimens of the lower plants, especially the algae, but a little acquaintance with the habits of these too little known forms, will reveal the fact that much of the anticipated trouble is imaginary.

The plant aquarium is, however, absolutely necessary for a consistent study of microscopic plants in laboratory classes. Most of the laboratory work in cryptogamic botany has by custom or accident, or I know not what other reason, been relegated to the winter or early spring months, and part of this time at least no live specimens can be brought from the field, supposing even that the teacher knew just where to get any given plants. We must then naturally fall back upon attempts at domesticating these lower forms or, to a large extent, fall back upon the less satisfactory methods of using pickled material or prepared slides. The best teachers will never for habit study give students prepared slides when living material is at hand, and in this way, endless explanations about stains and other artificial things are avoided.

We may say after a number of years study of the best ways of developing plants in the laboratory for class use, that we must at the very outset take for granted that the plant aquarium is as different from the average animal aquarium as their respective inhabitants are, and the treatment accorded each in order to succeed is entirely different, in fact, in most cases quite opposite. Even the vessels that give best results in growing or domesticating aquatic animals are entirely different from the vessels that will give good results in growing plants. These vessels are invariably of glass, because allowing better penetration of light, which is, of course, more necessary to plants than animals. It is pretty well conceded that large square vessels made of separate plates of glass, cemented together by various mineral cements, are bst adapted for ani-

mals. At least such large several pieced vessels seldom explode, or crack.

Microscopic plants are susceptible to subtle influences of environment which are mostly unknown to us. The plant aquarium must be entirely of glass or other absolutely insoluble material like porcelain. Metals in contact with water in plant jars are fatal. Carbon dioxide present in small traces in water where living things are growing will dissolve minute quantities of otherwise insoluble metallic compounds, such as rust or oxides, and carbonates resulting in the formation of more or less soluble bicarbonates. Soluble metallic salts are ionized in water and therefore toxic. These substances may be almost imperceptible to analysis or at least but traces, but there is enough to prove fatal to plants. Even tap water may contain too much iron in solution. Many microscopic plants seem to be killed off by iron almost as easily as by lead, and this would seem all the more strange as iron is a necessary constituent of chlorophyl. Other plants appear to resist the action of iron only because they are able in some way to precipitate it from solution as a sulphide, and thus render it harmless. This can be easily shown in jars when Protococcoideae abound. The walls of the vessel become coated with a brownish layer which can easily be washed off with dilute acids when hydrogen sulphide comes off. The conjugatae, especially Spirogyra, do not seem to be able to precipitate iron nor resist its toxic action. Not being able to get rid of it they promptly die.

It is not true that larger aquaria are best for growing algae, though such are unquestionably most desirable for animal development. My experience of some years past is that the valuable plants for class demonstration are grown in glass vessels of medium size of less than a gallon capacity and not exceeding two gallons. The very best plants, and often in great variety, have been growing in vessels holding little more than an ordinary tumbler carefully covered to prevent evaporation and access of dust. I have at present in the laboratory the best variety of desmids I have ever seen in a laboratory culture. The vessel is shallow and wide and when full, holds not quite a pint of water. It has stood covered for months and contains innumerable specimens of Staurastrum, as also several species of Closterium and Cosmarium. These are constantly dividing.

Another jar has stood in the laboratory for about six months, having been filled with some Spirogyra and other conjugatae from the field, together with some sticks and debris

in very small quantity. The Spirogyra has completely disappeared and the jar now contains, besides the prettiest Chroococcus I have seen, Oedogonium forming zoospores, Conferva with zoospores escaped, a very rare stage which I have never seen in the field. The plant is so common as to be a nuisance in spring, both in pools and in the laboratory. The small vessel has been systematically robbed of part of its contents for pickling and supplying other laboratories, and it still continues to develop new material of the old forms, and shows indications of producing new plants. This vessel is a round heavy glass box of the Bausch and Lomb make, and not more than four inches high and in diameter inside.

Some plants prefer shallow wide vessels, other grow best in deep vessels. I find that most prefer shallow ones, and when grown in deep ones develop generally only at the surface of the water. Fish globes are satisfactory but liable to crack and explode. Baloc beakers are cheapest and best because wide: those of five litres or less most convenient. They never explode, but are thin walled and must be handled carefully, especially when containing a soil or sand layer in the bottom. I have several twenty gallon aquaria but cannot remember a single really valuable plant or valuable stage of a common plant produced in them. They are excellent for preserving Utricularia, Salvinia, Lemna and larger aquatic plants. Utricularia is a valuable asset in the plant aquarium for trapping entomostraca, cyclops and other small animals in a plant culture. A plant immersed for a few days in the jar where these are present with valuable plants will soon reduce the animal devastators by catching them in their insectivorous bladders. They are then removed, as algae do not thrive with these higher plants present. Larger aquaria are especially good for growing small animals, such as entomostraca, snails, Fragania, Tubifex, planarians, Fairy-shrimps and hosts of others which live together harmoniously, or succeed one another. I have found that a larva stage of a dragon fly makes the best policeman for plant aquarium. When turned loose for a day or two destructive animals rapidly disappear. The larva lives long. I have had one do service for over a year. If left continuously in the plant jar its clumsy movements interfere with plant growth. There is no animal so destructive as the water snail. No plant culture will succeed when these are present and there seems no remedy, but to start without them. They must be picked out by hand one by one. Most of the animals mentioned, though valuable to the teacher of zoology for demonstration, are an intolerable nuisance in the aquarium. Animals should always be kept in separate jars

and they always get by themselves sooner or later, after devouring all traces of plants.

As to the method of treatment that appears to be beneficial in developing microscopic plants in the laboratory, we may say in general, that it consists essentially in a process of domestication. This is as true of plants as of animals. All processes of domestication give results in proportion to the degree that they succeed in giving the captives conditions as near as possible to those enjoyed in the field where they develop as in their natural home, or as near as possible to the conditions in which the captives can be coaxed to accommodate themselves easily.

Quite a variety of methods of treatment of plants in the aquarium have been discussed already,* and I refrain from repeating such explanations, and will refer only to the most important in passing, trusting that such of my hearers as are especially interested will be able to consult the article in question. The most important fact, in developing plant and also animal life in the laboratory jars when desired is to have nearby in the field, places where desirable specimens are wont to develop. By going to such places one can in a few days or weeks obtain excellent laboratory material out of season by a method already referred to. Even in winter when little plant life exists or is dormant, or in the drought of summer when the pools are dried up, one can by taking a handful of soil or mud or debris from such places obtain laboratory cultures by simply putting this soil in the jar in small quantity and covering with water, and awaiting results. One must be cautioned to use a small amount of such mud, less than one-twentieth of the whole contents, or bacterial decay will destroy everything. It does not always happen that the specimens especially sought appear, but usually some others as valuable develop. Nor does the same material come from the mud taken from the same places and put in separate jars. Size of containers and other unknown influences cause variations. This method I have compared to the "forcing" of the higher plants before their regular time, and it is elsewhere explained with detail. It is also explained why direct transfer of mature and fully developed forms to the laboratory is not so satisfactory as the "forcing" method. Every teacher of botany or zoology realizes, I believe, the importance of having available localities for collecting material, but it has not been so fully understood how necessary this is for the success of the laboratory aquarium.

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*The American Midland Naturalist, Oct., 1909, Vol. I, pp. 82-87.

What are the conditions of the best collecting grounds in the field? I have often observed the tendency of collectors of water plants to betake themselves to large bodies of water, rivers and lakes, and ponds, and have very often seen them return hopelessly discouraged. If they persist they lose much valuable time, and finally give up collecting, thinking that their locality is barren. The best results are obtained from pools of water that are dried up part of the year. Wherever water constantly collects so as to be wholly submerged the year around, frogs, large water insects, aquatic and even fish will gain an access and destroy plant life. The plants can hardly develop their spores before being devoured by these enemies. Moreover, the period of rest during the dry season seems necessary to preserve the vitality of some algae. It is a matter of observation that few microscopic plants grow in large bodies of water, except Cladophora Hydrodictyon, Draparnaldia, Chaetophora, Chara. To prove how fish relish spirogyra, a small amount may be put in a globe with goldfish and it will rapidly be eaten.

Many collectors attempting laboratory cultures in aquaria have somehow got passessed of the idea that the water must be changed to prevent decay. I have thoroughly discussed this, but too much emphasis can not be laid on the matter. *Paradoxical as it seems, few plants can stand such treatment, and most will either die or be much retarded in development. A moment's reflection will tell us the reason. I have said that microscopic plants find great difficulty in adjusting themselves to surroundings, because being so small, they are benefitted or injured by insignificantly small factors, and it is just because they have great difficulty in accommodating themselves to new environment that we must refrain from putting them in a new condition by daily changes of water. In the second place, when plants are present in healthy condition, the very oxygen they give off is a check on bacteria, and when healthy, they can keep the water purer in this way than we can by changing it.* Water is not impure because green plants grow in it. Moreover, green plants are put in fish aquaria in order to keep the water oxygenated.

When it is necessary to bring fully developed plants into the laboratory aquarium from the field, they should be allowed to remain in the water taken from their habitat, unless there is a chance of a new generation developing. Some algae may stand the changes of water once, many promptly rebel and die. We may then take the chances of getting a new culture from the spores produced as the plants disappear. In any case, by keeping all cultures several months before throwing out a jar

which seems to be unproductive for a time, we often find some remarkable growths later. Absolute decay by bacteria indicated by changes of color and offensive odors as also complete choking up of the contents by oscillatoria are the signs that the contents of a jar are beyond the stage of future usefulness.

The reason why the "forcing" method is the best is the following. Mud collected in the field in dry or adverse conditions, even in winter, contains spores which seem in the resting stage eagerly awaiting a chance to develop. They will come out even under comparatively unfavorable conditions or will then make a special effort to accommodate themselves to even a possible existence. They will even develop in the laboratory in winter, because the change from the field to warm room is not unlike the advent of spring to them, especially if the light is strong. Resting stages contained in the mud can more easily resist adverse conditions. Plants and animals go into the resting stage or form hypnospores for this very reason of resisting adverse conditions.

Plant aquaria should be covered with a plate glass, both to keep out dust and also to prevent rapid evaporation. Water will evaporate slowly despite all efforts. This must be replaced little by little. Adding too large an amount at one time may prove fatal. The addition is also necessary to keep up the available food salt of the plants. Addition of water must never exceed one-fifth of the contents of the aquarium. The salts used by plants and present in all natural water may be also replaced by adding Sach's tablets, as these contain the proper proportion of mineral salts necessary to their development.

Good light, in fact very strong, and direct sunlight is necessary to many algae. The average material develops well, however, in diffuse sunlight. I have tried for some years to keep up cultures of Euglena, Pandorina Haematococcus or Sphaerella in the laboratory but without success, and have finally found that my failures were due to want of sunlight. These plants, I have already shown, grow best in midsummer in places where organic matter is decomposing in direct blistering sunlight, e. g. the wallows of pigs, pools around watering places, and near barns. I have once seen a basin of water containing manure at the bottom and covered one-half an inch deep with the Englena. This pool about 30x60 feet square was covered by a layer of the purest culture of Euglena. I have even found in the motile stage. It would be a pretty problem of mathematics to attempt to calculate the number of organisms present when we reflect that the animal, as you

may wish to call it, is only 30-40 microns long. (Less than 1-500 of an inch.

Our professor of zoology can obtain and keep vegetative euglenae at will, by putting some crumbs of bread in a jar of stagnant water. Bacteria and mould will come out only in small quantities because it decays in direct sunlight. He obtained Haematococcus and even the rare stages of conjugation and daughter cell formation, by taking debris from a place where such were found in the field and adding rain water. His laboratory is, however, on the south side of the building where he has direct sunlight most of the day.

Microscopic animals, on the other hand, seem to develop better on diffuse sunlight and in large vessels. I have obtained some specimens of Zoothamnia, fragania, fairy-shrimps, and spongelike animals that were quite rare, or were not reported from this part of the country, and they develop in great numbers. Hydras, both the small green species (*H. viridis*) and the larger chlorophylless one (*H. fusca*) come in great abundance in late spring and early summer, both in large and medium sized aquaria and are usually found together, the latter disappearing first as its food gives out, the former chlorophyl bearinf remaining for months.

When water is too alkaline, or contains too much lime in solution, a few plants of chara should be introduced into the aquarium. The plant is called Stonewort, because of large quantities of calcium carbonate present in it. Plants introduced in summer grow readily and fruit well the oospores remain in good condition till germinating in spring.

Tapwater is used for the aquarium unless it contains too much iron. The water must be allowed to run some time before filling a jar, as water standing in pipes, especially iron or lead pipes, is dangerous. Water contains iron when it leaves a brown spot, where it drips constantly.

An inch of sand in the bottom of vessel is sometimes beneficial, when animals are present it is objectionable as they find a refuge, then bury themselves and can with difficulty be removed. Soil is sometimes good but often serves as a hiding place for worms like Tubifex, and this might be remembered by those who want animal rather than plant forms. When soil is taken from the natural habitat of the plant it is an advantage, but when taken in larger proportion than one-tenth of the contents of the jar, will usually grow more animals than plants.

In transfering algae from the field to the laboratory only a very small amount of material should be put in each jar, or decay will result rapidly. Though algae appear sometimes in

aquaria in dense masses leaving little room in a jar, it must be remembered that they do so only after they have made their environment favorable by counteracting all adverse influences. Large quantities of algae can never be kept in the laboratory unless they appear of their own accord. Conjugatae are especially difficult. Ulothrix is out of the question as are all forms that thrive in running water.

The stage of congugation of Spirogyra is seldom developed in the laboratory, possibly because of insufficient sunlight. Nearly all conjugatae except *Spirogyra nitida* conjugate in Spring. (April, May.) Desmids conjugate but never abundantly in captivity. Diatoms and zoospores of Vaucheria develop best from material brought into the laboratory in winter. The former become extremely active when brought from the cold outside to the warmth of the laboratory. The latter seem to be affected by the change as if spring came. They produce numerous zoospores in a few days. Nearly all algae appear periodically though the periods are not fixed, and therefore the contents of a jar not containing active bacteria nor infested with oscillatoria should not be thrown out too soon. Algae are at times slow in coming out, but great varieties follow one another once the conditions are favorable. A recent example in my laboratory will illustrate this point. Some Spirogyra was put into a jar last summer. It contained some Mougeotia and Zygnema also, besides a small amount of grass blades and debris. The vessel was put aside in strong light and almost forgotten till one day a month ago, a deposit of plankton was found in the bottom. Examination revealed a small amount of the aforesaid algae but large quantities of zoospores of conferva and some oedgonium in similar stage. Chroococcus was abundant later. This jar of not over one and one-half pint capacity contained the best stages of these algae I have seen. The jar was robbed systematically and is still developing. Protococcus forms are just beginning to appear.

Laboratory cultures are usually better than field cultures, not only because they are, generally speaking purer, but because they afford continuous study of successive stages. In the field even, one is often tempted to do superficial cursory examinations of larger areas rather than intensive continual observation of one small pool. Needless to say, the latter method brings best results. We shall be astonished what a great variety of specimens we may obtain from one small pool, if we watch it carefully and long enough. I obtained the largest amount of my best and rarest material from some drain holes along a railroad only a quarter of a mile of its length. The laboratory jar is always at hand and ready for examination,

hence most convenient for intensive work. Even when we have a good field for collecting, the aquarium is an indispensible adjunct to class work, and ever for research. Ecology and habits of plants and animals cannot be studied as well in the field as in the transparent jar. I will cite but a simple example. The omnivorous worm, Tubifex, is an inhabitant of pools periodically dry, and in sluggish streams it is often so abundant that the bottoms are colored red by the large number. There has been considerable comment whether this worm, Tubifex, (so called because it builds a case or tube around itself), has its anterior in the mud or out of it. These animals are constantly swaying back and forth in rhythmical motion, to cause water currents. They are often several inches long, about the thickness of a thread, and the approach of any enemy causing a disturbance in water near, is sufficient to make them retreat instantly into the ground and no trace of them is seen until quite is restored. Some will invariably dig down at the edge of the aquarium and their anatomy from one end to the other may thus be studied through the glass with a magnifier, and without in the least disturbing them. Sound waves do not seem to effect them, though sound travels in water and when the vessel is struck a sharp resounding rap, they are not affected as some other small aquatic animals are. Some zoologists have maintained that these worms are imbedded "head first" in the mud, others claim their heads or anterior portion is extruded, and I am told that the matter has not been settled. Now it does matter very much whether a worm wants to stand on its head or otherwise, but it is very easy to settle the problem viewed in the aquarium, though in the field none seem to have been able to decide. A few moments observation will show to the veriest tyro that the food which these worms are continuously eating is seen passing upwards through their transparent bodies and finally cast out above, causing in part, the formation of the tube around them, from which they get their name. I have asked many students, some mere beginners, and all could solve the difficulty in a few seconds of observation.

This is only one instance to show that if we wish to become better acquainted with the lower forms of life we must bring them near to us and study their ecology. The difficulties of field study are such that little has been done heretofore with algae ecology. The aquarium for microscopic plants may in the future solve some of these problems, besides being a help and convenience for class work.

Summary of Requisites for Success With the Laboratory Aquarium.

1. Use the right kind of jar, i. e., smaller one-pieced glass vessels for plants and larger ones for animals; shallow and wide aquaria for plants, deeper ones for animals.
2. Good light. Diffuse daylight is generally best. Direct and even strong sunlight for algae grown in summer.
3. Avoid access of dust and minimize evaporation.
4. Avoid presence of mineral salts and alkalinity of water.
5. Never change water nor add more than one-fifth of contents of the jar.
6. Advantages of the "forcing" method should be realized. Therefore, contents of an aquarium should be kept several months unless bacteria or oscillatoria or animals invade it. Give the spore stages a chance to appear.
7. Remove all animals as much as possible from plant aquaria.
8. Study the ecology of specimens in the field, and give the specimens in the laboratory jars as much as possible their native outdoor habitat, e. g., regarding light intensity, depth of water, kind of water, etc.
9. Find a good collecting ground preferably pools, dry part of the year, in order to replenish the laboratory jars, and do intensive rather than extensive field work.
10. Interest, perserverance and patience especially at the start.

Our Birds in October and November.

BROTHER ALPHONSUS, C. S. C.

The reason why the writer failed to see three species of birds on one day only in October can be accounted for in two of the instances. On the 16th he did not visit a certain piece of lowland overgrown with brush, where he always found the Goldfinch, and on that day he did not see the bird elsewhere. The Song Sparrow was not seen on the 29th, the first time it was not found since its arrival on March 6th. Up to the date of its departure, on Nov. 8th, the bird was seen irregularly. I cannot account for not seeing the Snowbird, unless it be

that this species usually moves in flocks, seldom leaving individuals behind.

The fact that the Brown Creeper was seen only twice in October and four times in November leads me to think that this species is not abundant here. If this is not the case, like the scarcity of the Chickadee, I am unable to account for the Creeper's rarity in this locality.

During October the White-throated Sparrow was abundant as the Snowbird, but not so widely distributed as the latter species. The former shows a preference for swampy land. The Golden-crowned Kinglet was both abundant and widely distributed. The writer thinks the Bobwhite is now a rare bird in St. Joseph County. It was found by him only on one day, in October, since March 1, 1909.

In November the appearance only on one day of the Cardinal, Northern Shrike, Hairy Woodpecker, Belted Kingfisher, Mourning Dove and Towhee was due to the fact that these were migrating birds.

OCTOBER.

Bird seen every day: Blue Jay.

Birds not seen on any day: Purple Finch, Ruby-crowned Kinglet.

Birds seen every day except on dates after their names:

Snowbird, 22.
Myrtle Warbler, 10, 11, 26, 27, 28, 29, 30, 31.
Goldfinch, 16.
Chipping Sparrow, 11, 12, 14, 15, 17, 20, 25, 27, 29, 30, 31.
Golden-crowned Kinglet, 28, 29, 30, 31.
Crow, 13, 21, 27, 30.
Song Sparrow, 29.
White-throated Sparrow, 5, 25, 27, 28, 29, 31.

Birds seen on dates after their names:

Brown Creeper, 6, 16.
Yellow Palm Warbler, 14.
Chickadee, 24, 25, 29.
Downy Woodpecker, 11, 12, 17, 18, 19, 22, 23, 25, 26.
Killdeer, 3, 5, 7, 8, 9, 16, 28 to 31.
Yellow-billed Cuckoo, 6.
Flicker, 1, 2, 5, 9, 14, 15, 23.
Field Sparrow, 1, 8.
White-breasted Nuthatch, 2, 4 to 8, 12, 15 to 20, 22, 29.
Chimney Swift, 2, 3.
Bluebird, 1, 2, 4, 6, 14, 15, 16, 18, 19, 20.
Cowbird, 4, 6, 15, 16.
Brown Thrasher, 4, 5, 6, 9, 10, 11.
House Wren, 6, 7, 15.
Towhee, 9, 15, 17 to 27.
Nighthawk, 13.
Bobwhite, 24.
White-crowned Sparrow, 1 to 4, 6, 16, 18.
Hermit Thrush, 2, 6, 7, 12 to 16, 18, 20, 21.

Mourning Dove, 2, 3, 5, 7, 8, 24.
Kingfisher, 4, 10, 11, 12.
Screech Owl, 24, 30, 31.
Meadowlark, 1, 2, 4to 7, 9, 16, 17, 23, 26, 27.
Robin, 1, 2, 3, 5 to 9, 11, 13, 14, 16, 17, 18, 24, 26.
Vesper Sparrow, 1.
Yellow-billed Sapsucker, 4 to 9.
Kirtland Warbler, 4.
Purple Grackle, 6, 9.
Phoebe, 7, 9, 13.
Yellow-throated Vireo, 11.
Fox Sparrow, 20, 22.
Hell Diver, 12, 15, 24, 29.

Number of species seen each day:

October 1, 16.
" 2, 18.
" 3, 14.
" 4, 18.
" 5, 16.
" 6, 22.
" 7, 18.
" 8, 15.
" 9, 17.
" 10, 10.
" 11, 12.
" 12, 13.
" 13, 11.
" 14, 13.
" 15, 15.
October 16, 16.
" 17, 13.
" 18, 16.
" 19, 13.
" 20, 13.
" 21, 10.
" 22, 12.
" 23, 13.
" 24, 16.
" 25, 9.
" 26, 10.
" 27, 7.
" 28, 7.
" 29, 7.
" 30, 6.
" 31, 5.

Total number of species seen, 41.

NOVEMBER.

Birds seen every day except on dates after their names:

Snowbird, 6, 7, 14, 16, 22, 27.
Crow, 1, 6, 7, 9, 10, 11, 13, 16, 19, 20, 22.
Blue Jay, 14.
White-breasted Nuthatch, 1, 5, 6, 7, 11, 13, 14, 16, 17, 22.

Birds seen on the dates after their names:

Flicker 2, 17.
Song Sparrow, 2, 3, 4, 7.
Robin, 3, 26.
Downy Woodpecker, 4, 7, 12, 15, 16, 19, 20, 21, 23, 25 to 28, 30.
Brown Creeper, 12, 13, 27, 29.
Cardinal, 19.
Screech Owl, 25.
Mourning Dove, 29.
Golden-crowned Kiglet, 2, 12, 13,16,19.
Goldfinch, 3, 7, 8, 12, 15.
Belted Kingfisher, 8.
Tree Sparrow, 9, 12, 13, 14, 15,
Towhee, 15.
Hairy Woodpecker, 23.
Northern Shrike, 29.
Bobwhite, 30.

Number of species seen each day:

November	1, 2.	November	16, 3.
"	2, 7	"	17, 4.
"	3, 7.	"	18, 4.
"	4, 6.	"	19, 6.
"	5, 3.	"	20, 4.
"	6, 1.	"	21, 5.
"	7, 4.	"	22, 1.
"	8, 6.	"	23, 6.
"	9, 4.	"	24, 4.
"	10, 3.	"	25, 6.
"	11, 2.	"	26, 5.
"	12, 8.	"	27, 5.
"	13, 4.	"	28, 5.
"	14, 2.	"	29, 6.
"	15, 8.	"	30, 6.

Total number of species seen, 20.

Total number of species seen in October and November, 46.

Notes on Priority of Plant Names.

J. A. NIEUWLAND.

In looking through the second edition of the Herbarium Blackwellianum, published by Trew,* I found that this author in his own notes to this great work had restored a number of older generic plant names before other authors to whom they have been usually accredited.

These restorations are always made under the special caption, "NOMEN GENERICUM," so that their significance can not be doubted.

Elizabeth Blackwell's names seem to be left quite as they were in the original pre-Linnaean edition, and I shall not make any reference to these. The famous handcolored plates of the first Herbarium Blackwellianum are also reproduced. The following cases of priority are worthy of mention:

* Herbarium Blackwellianum, by Elizabeth Blackwell, Second edition in Latin and German, Century I-V, re-edited by Christopher Jacob Trew, Century VI, or Appendix by Christian Gotlieb Ludwig. Norimbergae, 1754 -1773. [The volumes have no page numbers in the text, only the plates being numbered.]

(1) *Bursa*, Trew, 1757†, instead of
Bursa, Ludwig, 1760, or
Bursa, Wiggers, 1780, or
Capsella, Medicus, 1792.

The genus is not published in a way that would lead one to suppose the name is a generico-specific binary. The genus is referred to Heucher, 1711, who also uses the single word, *Bursa*, and who was the first to publish it under that caption.

(2) *Persicaria*, Trew., 1754, instead of
Persicaria, Hill, 1756.

The first species mentioned in a binary Trivial name *Persicaria maculata* or *Persicaria maculosa*, hitherto called *Polygonum Persicaria*, and the type of the genus *Persicaria*. It is worthy of note that Trew also reduces to this genus what the old herbalists called Hydropiper, or as we know it, *Persicaria Hydropiper*. He does not, however, designate the species under a binary name as he does in the case of *Persicaria maculata*.

(3) *Coronopus*, Trew, 1754‖, instead of
Coronopus, Zinn, 1757.

(4) *Tithymalus*, Trew, 1754§, (in part) instead of
Tithymalus, Duhamel, 1755.

(5) *Abies*, Trew, 1754,** instead of
Abies, Duhamel, 1755.

(6) *Sassafras*, Trew, 1757,†† instead of
Sassafras, Nees and Eberm, 1831.

Through a reprint of 1866 there has come to my notice the fact that in 1754 there had been published a work or rather a list of plants* from the Botanical Garden of Amiens, France. The author is stated by M. Richer† to have been Dom. Robbe, founder of the botanical garden of that city. Robbe's name does not appear on the title page, and the list was "published

† l. c. Cent. I, Tab. 5.

‖ Heucher, J. H., Index Plantarum Horti Medici Academiae Vitembergensis, 1711, p. 14. "*Bursa*. Vulgo Bursa pastoris offic."

‡ l.,c. Cent.II, Tab. 118.

‖ l. c. Cent. II, Tab. 120.

§ l. c. Cent. II, Tab. 123, and 163.

**l. c. Cent. II, Tab. 198.

††l. c. Cent. III, Tab. 267.

* (Dom. Robbe.) Catalogue des Plantes Usuelles avec une explication des principaux Termes de Botanique, poor servir d'intrduction aux Démonstrations commencees dans le jardin de Botanique le 27 Juin 1754. Sous les auspices De Mgr. le Duc De Chaulnes, etc.

A Amiens, Chez la Veuve Godart, Imprimeur du Roi, de Mgr. le Duc de Chaulnes et de l' Academie. MDCCLIV.

† M. Richer, Discours prononcé a l' ouverture du cours communal de Botanique de la Ville d'Amens le 16 Mai, 1866, p. 74.

under the auspices of Mgr. le Duc. de Chaulnes." A number of generic names appear in this list, earlier than in any other work of my knowledge, and the identity of them is always made clear by references to the works of such authors as Tournefort, Caspar Bauhin, Morison, etc. If under these circumstances credit is due to Robbe for priority of publication, I leave to others to decide. The following names seem to be affected. I shall also add the names of authors, to whom the plants have hitherto been attributed since 1753.

(1) *Tithymalus.* (p. 102.) or
Tithymalus, Trew, 1754,
Tithymalus, Duhamel, 1755.*
Five species are mentioned.

(2) *Malus.* (p. 103.)
Malus, Duhamel, 1755.

(3) *Filipendula.* (p. 110.)
Filipendula, Hill, 1756.

(4) *Abies.* (p. 111.)
Abies, Trew, 1754.
Abies, Duhamel, 1755.

(5) *Ulmaria.* (p. 112.)
Ulmaria, Hill, 1756.

(6) *Cerasus.* (p. 115 and p. 138.)
Cerasus, Duhamel, 1755.

(7) *Lauro-Cerasus.* (p. 115.)
Laurocerasus. Duhamel, 1755.

(8) *Argentina.* (p. 119.)
Argentina, Hill, 1756.

(9) *Dracunculus.* (p. 120.)
Dracunculus, Morandi, 1761.

Dracunculus polyphyllus is given as a binary Trivial name to the species.

(10) *Polygonatum.* (p. 125.)
Polygonatum, Hill, 1756.

(11) *Bistorta.* (p. 125.)
Bistorta, Hill, 1756.

(12) *Persicaria.* (p. 129) also
Persicaria, Trew, 1754.
Persicaria, Hill, 1756.

Four species are mentioned; what we call *Persicaria maculosa* or *Polygonum Persicaria,* Linn., *Persicaria Nicotianae folio, Persicaria mitis floribus candidis,* C. B. P., p. 192, and *Persicaria urens seu Hydropiper,* C. B. P., p. 107.

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* For references of synonymes see Am. Mid. Nat. pp. 16 et seq. 49 and 164.

(13) *Chamaenerion.* (p. 129.)
Chamaenerion, Ludwig-Böhmer, 1760.
(14) *Melilotus.* (p. 130.)
Melilotus, Hill, 1756.
(15) *Fagopyrum.* (p. 135.)
Fagopyrum, Hill, 1756.
(16) *Alnus.* (p. 136.)
Alnus, Duhamel, 1755.
(17) *Lycopersicon.* (p. 137.)
Lycopersicum, P. Miller, 1759.
(18) *Valerianella.* (p. 138.)
Valerianella, Hill, 1756.
(19) *Grossularia.* (p. 138.)
Grossularia, Duhamel, 1755.
Two species of the last are mentioned.
(20) *Albutilon.* (p. 133.)
Abutilon, Hill, 1756.
(21) (H) *Elianthemum.* (p. 131.)
Helianthemum, Shaw, 1757.
(22) *Pulsatilla.* (p. 105.)
Pulsatilla, Hill, 1756.

Dryopteris a Synonym.

J. A. NIEUWLAND.

Adanson's name *Dryopteris** has been recognized as an older one for the genus formerly called *Aspidium,* Swartz, 1800.† It has been found, however, that since 1753 Schmidel‡ gave a name earlier than either of the above to this group of ferns. Though the authors of *Dryopteris* and *Aspidium* seem to choose as the type of the genus the Linnaean species *Polypodium Filix mas* Linn., Schmidel chose the plant of Linnaeus called *Acrostichum Thelypteris,* Linn., but both of these are not considered separated into different genera at present.

Schmidel in restoring the name *Thelypteris* refers to Ruppius.* Kuntze believes that the *Thelypteris* of Ruppius is

* Adanson, M., Familles des Plantes, 1763. Vol. 2., p. 20.
† Swartz, O., Schrad. Jour. Bot. 2:4. 1800.
‡ Schmidel, Casimir Chr., Icones Plantarum et Analyses Partium, curante et edente Joannes Chr. Keller, Pictore Norimbergensi Typis Christiani de Lavnoy, 1762. Manip. I, Secto 1, p. 45.
* Ruppius, Haller, Fl. Jen. 1745.

the same as Adanson's *Thelypteris* or the *Thelypteris* of the ancients, which plant is none other than *Pteris aquilina*, Linn., now type of the genus *Pteridium*. On the basis of absolute priority this name is the true one for what we now call *Pteridium aquilinum* (Linn.) Kuhn. Such is the confusion caused by not accepting the older pre-Linnaean names for plants. This is but a single instance of many where botanists who go back no further than 1753 for their names, must if consistently following their principles to their logical conclusion, accept names given as the result of misunderstanding of the authors who first quoted them. Whatever may have been the *Thelypteris* of Ruppius, or of the ancients, there can be no doubt that the *Thelypteris* of Schmidel is *Dryopteris Thelypteris* (Linn.) A. Gray, and therefore, the oldest name since 1753 for any segregate form Linnaean genera containing *Acrostichum Thelypteris*, Linn,

Schmidel devotes four folio pages to the description, and history of the plant. A full page plate [Plate XII.], colored, of the plant is given. One-third of his plate XIII. contains illustrations with explanations of the arrangement of sori and sporangia. The description together with the exact plates showing spore dehiscence and other even microscopic characters is so minute and convincing, that any one knowing the plant, *Dryopteris Thelypteris* (Linn.) A. Gray, would recognize it at a glance. I have reproduced the plates of Schmidel herewith.

The function of annulus of the sporangium in dispersal of spores is perfectly described and illustrated, together with other microscopic details. Considering the age of the work with its drawings and description the publication is certainly remarkable.

Although, therefore, *Thelypteris* is the pre-Linnaean name for *Pteridium* and the valid one on the basis of absolute historic priority, the name as applied by Schmidel to *Acrostichum Thelypteris*, Linn., makes it the oldest for the genus *Dryopteris*, since 1753. Following is the synonymy of genera and species. As I have no sympathy for confounding names, nor feel any respect for codes, congresses, or systems of nomenclature that by contradictory rules bring about such confusion, I do not want to be responsible for even the new combinations, and only indicate a few for the sake of making clear the changes that may be followed by such as consider 1753 as the beginning of nomenclature in modern botany.

Thelypteris (Ruppius?*) Schmidel, 1762, not *Thelypteris*, Adanson, 1763 or other pre-Linnaean authors.
(*Dryopteris*, Adanson, 1763.)‡
(*Aspidium*, Swartz, 1800.)
(*Lastraea*, Presl. 1851.)†

(1) *Thelypteris palustris* (Ruppius*) Schott, 1834.
Dryopteris Thelypteris (Linn.) A. Gray, 1846.
(*Aspidium Thelypteris* (Linn) Sw., 1800.)
(*Thelypteris Thelypteris!*)
(*Acristichum Thelypteris*, Linn., 1753.)
(*Lastraea Thelypteris* (Linn.) Presl.)

(2) *Thelypteris simulata* (Davenp.).
(*Aspidium simulatum*, Davenp., 1894.)
Dryopteris simulata, Davenp., 1894.

(3) *Thelypteris noveboracensis* (Linn.).
Dryopteris noveboracensis (Linn.) A. Gray, 1848.
(*Aspidium noveboracense* (Linn.) Sw., 1800.)

(4) *Thelypteris fragrans* (Linn.)
Drypteris fragrans (Linn.) Schott, 1834.
(*Aspidium fragrans* (Linn.) Sw., 1800.)

(5) *Thelypteris marginalis* (Linn.).
Dryopteris marginalis (Linn.) A. Gray, 1848.
(*Aspidium marginale* (Linn.) Sw., 1806.)

(6) *Thelypteris Filix mas* (Linn.).
Dryopteris Felix mas (Linn.) Schott, 1834.
(*Aspidium Filix mas* (Linn.) Sw., 1800.)
(*Polypodium Filix mas*, Linn., 1753.)

(7) *Thelypteris Goldiana* (Hook.).
Dryopteris Goldiana (Hook.) A. Gray, 1848.
(*Aspidium Goldianum*, Hook., 1822.)

(8) *Thelypteris Bootii* (Tuckerm.).
Dryopteris Bootii (Tuckerm.) Underw., 1893.
(*Aspidium Bootii* Tuckerm, 1843.)

(9) *Thelypteris cristata* (Linn.).
Dryopteris cristata (Linn.) A. Gray, 1848.
(*Aspidium cristatum* (Linn.) Sw., 1800.)

(10) *Thelypteris spinulosa* (Retz.).
Dryopteris spinulosa (Retz.) Kuntze, 1891.
(*Aspidium spinulosum* (Retz.) Sw., 1800.)

University of Notre Dame.
Dept. of Botany.

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‡ Adanson, M. Familles des Plantes, 1763, p. 20.
† In C. Babington's Manual of British Botany, 1851. Ed. III.
* Ruppius, H. B. Fl. Jen. Ed. II, p. 277 (1726)
Thelypteris palustris non ramosa.

The Passenger Pigeon.

F. J. WENNINGER

The habit of association in large herds common to some animals served to protect them under primeval conditions. But when man came upon the earth, these very conditions operated to the disadvantage of the animals in question. Among the best known examples to be cited in illustration of this fact are the Bison, the Beaver, and Wapiti and Deer, the history of whose extermination is too well known to require repetition.

Just now, we are confronted with the fact that another of our once common animals has become so scarce that it is questionable of existence. This time it is a bird,— the Passenger Pigeon (*Ectopistes Migratorius*).

This bird was once exceedingly common, so common that reports on the number of this pigeon contained in some of the treatises on Ornithology of the last century, are little short of fabulous. In 1813, the celebrated Audubon observed a flock of passenger pigeons numbering at least 1,115,000,000 individuals. Studer in his "Birds of North America" published seventy-five years after Audubon's work, refers to the size of the flocks of these birds which he observed. He says, "the flocks were very large but none even one-fourth the size of those seen by Audubon." In "Bird Neighbors," by Neltje Blanchan, 1898, only a decade after Studer's calculations were made, the passenger pigeon had already become so scarce that the writer remarks, "the bird is now too rare to be included among our bird neighbors." Again, in 1901, an observer writing for the "Library of Natural History," gives a detailed description of the bird and its habits. This author also concludes with a reference to the growing scarcity of the bird. "The vast numbers of this pigeon," he writes, "have greatly diminished during recent years and now the bird is on the verge of extinction. It is certain that unless laws are made for its protection, its extermination is only a matter of time." Reed's, "Bird Guide," 1909, contains no mention whatever of the bird.

All the vast region ranging along the eastern part of North America as far west as the Mississippi Valley and north to the Hudson Bay, once so thickly populated with this bird that as many as ninety and even a hundred and ten nests have been counted on each tree for a distance of three miles,—all this territory is now so entirely devoid of representatives of this species that there is grave reason for doubting the existence of the bird.

There is now a movement on foot to prevent, if possible, the complete extinction of the passenger pigeon. At a recent meeting of the American Ornithological Union the matter was discussed by Prof. Hodge of Clark University. In consequence of this, a prize has been offered for "the first information of a nesting pair of wild passenger pigeons *undisturbed.*" It is the hope of Col. Kuser, the donor of this prize of $300, that its offer will stimulate workers in the field of Natural Science and will promote efforts towards the protection and safety of this bird. Shortly after Col. Kuser's offer was announced, John Lewis Childs added a prize of $700 to the original award. Thus the first undisturbed nesting pair of passenger pigeons found anywhere on the North American continent will be worth one thousand dollars to the finder.

Occasionally the warning is sounded that some bird or beast is becoming extinct. But efforts to preserve these animals are usually extremely feeble in comparison to the cry raised over species that are already extinct. No amount of criticism will restore the Bison to our Western plains. The thing to do is to stop the wanton destruction going on at present. Just now it is the jays and especially the eagles that are diminishing in numbers. If instead of lamenting the ravages of animal life in the past, well directed efforts were made to prevent their repetition in the future, something worth while would be accomplished.

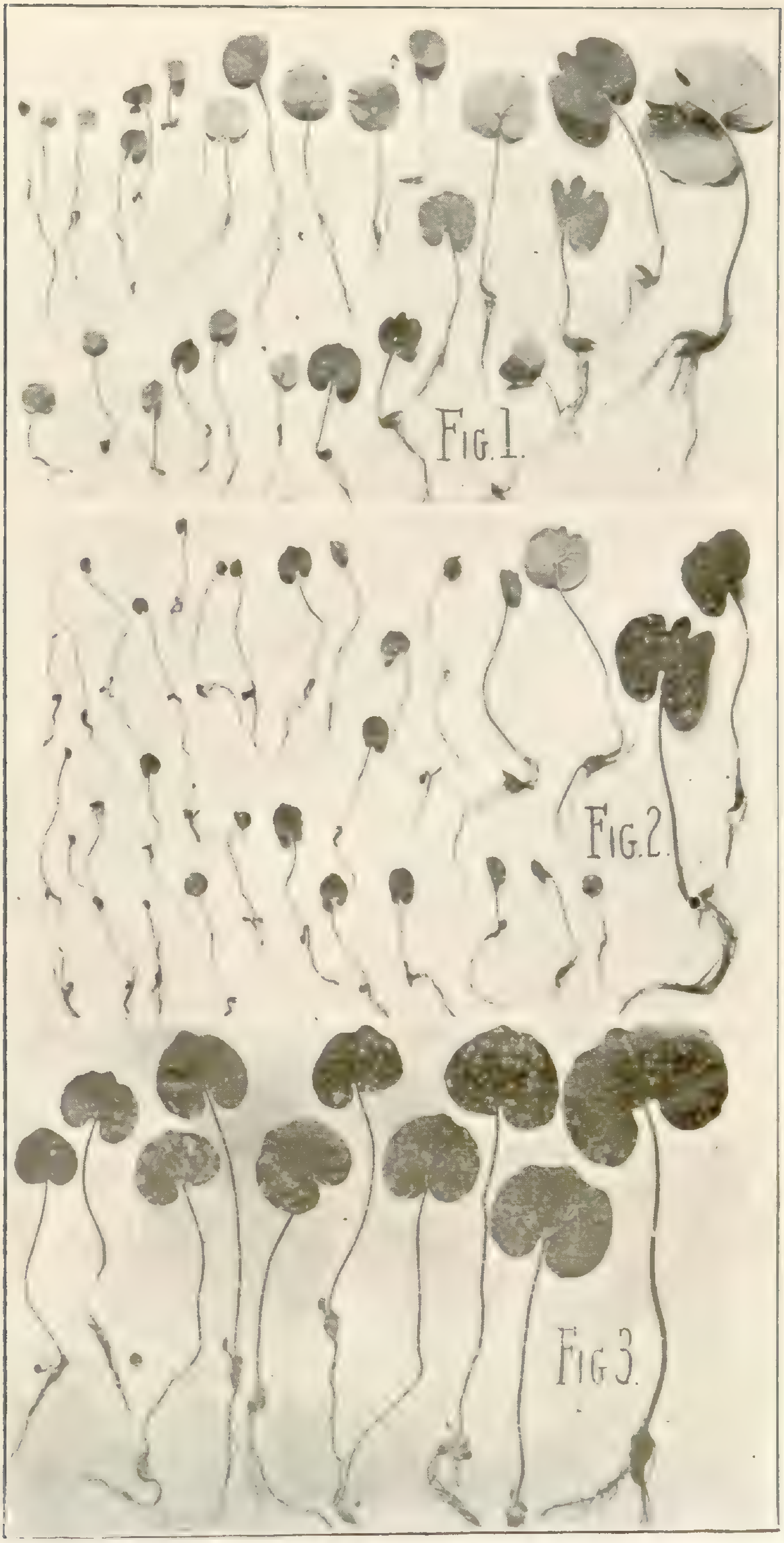

PLATE XV NIEUWLAND ON BLOODROOT.

Figs. 1 and 2 about ¼ natural size.
Fig. 3 One half natural size.

Photo by J. Huerkamp

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Notes on the Naiad Fauna of Northeastern Iowa.

S. W. GEISER.

In this paper are embodied the results of careful and extensive investigations carried on by the writer in the northeastern part of the state of Iowa during the past three years. The collections made, now in greater part in the Museum of the Upper Iowa University, have been made chiefly from three rivers in this section. The Wapsipinicon, a large, sluggish prairie stream with a bottom varying from the mud of the slough bottom, to sandy, gravelly, or even stony bottoms—has been systematically examined from Quasqueton, in Buchanan County, to Fairbank, in the extreme northwest portion of that county, a distance of about thirty-five miles, while occasional collections have been made as far north as Chickasaw County. The Turkey has been collected from at various points, notably at Elgin. In general characters the Turkey resembles the Wapsipinicon, but it is not nearly as large and it is also much more rapid. From the Volga, collections have been made from about fifteen miles of its course. These collections, augmented by contributions and exchanges from other streams in northeastern Iowa, gave me a fair basis for work. Specimens upon which this study is founded are contained in the Museums of the Upper Iowa University and the Chicago Academy of Sciences.

It is believed that the notes here presented may be of interest, since the work that has hitherto been carried on in the study of Naiades of Iowa has been rather confined to southern and southeastern Iowa. For whatever we know of the distribution of the freshwater mussels appearing in the state, we are indebted to a number of naturalists. Lea[1] (1857) and Pratt[2] (1876) described new species from the waters of the state, and general catlogues have been prepared by Witter[3] (1878)

(1) Proc. Acad. Nat. Sci. Phila. IX: p. 84. (1857).
(2) Proc. Dav. Acad. Sci. 1876: pp. 167-168.
(3) Quart. Joun. Conch. 1878: pp. 385-394.

* October 15, 1910.—Pages 229 to 244.

and Keyes[4] (1888). Other papers by Pratt[5], Tryon[6], Call[7], Shimek[8], H. M. Smith[9] and Kelley[10], etc., cast further light on limited areas. The latter and more recent catalogue of the naiades of Iowa, which was based on previous work as well as on original investigation, enumerates 66 "species" of Unionidæ which Keyes includes in the following genera: ANODONTA, 11; MARGARITANA, 7; UNIO, 48. A number of the enumerated species have since been reduced to the synonymy of other forms, but we believe that the number of reported species will be increased upon a more thorough examination of the streams of the state. From a study of his localities, it is apparent that the work of Keyes was confined to the Mississippi, Iowa, Cedar, Des Moines, Raccoon, Missouri, Rock (Northwestern Iowa), and Shell Rock rivers, and to Okoboji and Spirit Lakes, and some of his statements as to the distribution of certain Uniones will have to be modified as the result of subsequent investigations.

To the following specialists we are indebted for literature, material, advice and help: Mr. Frank C. Baker, Curator of the Chicago Academy of Sciences; Dr. Paul Bartsch, of the Division of Mollusks of the United States National Museum; and to Dr. R. Ellsworth Call of the De Witt Clinton High School, New York City. To Mr. Hartness de W. Taylor, the writer is greatly indebted for valuable services rendered in the field.

List of Species.

FAMILY *UNIONIDAE*, FLEMING, 1828.

GENUS *LAMPSILIS* RAFINESQUE, 1820.

1. *L. alatus* (Say, 1816) Baker, 1898.
   Occurs quite rarely in the Wapsipinicon and Turkey rivers.
2. *L. anodontoides* (Lea, 1834) Baker, 1898.
   Common in the Wapsipinicon.
3. *L. ellipsiformis* (Conrad, 1836) Simpson, 1900.
   Volga river at Fayette; Wapsipinicon river at Independence and various other localities.

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(4) Bull Essex Inst. XX: pp. 61-83. (1888).
(5) Proc. Dav. Acad. Sci. 1876: pp. 165-167; ibid. 1878: pp. 156-16?
(6) Am. Jour. Conch. 1865: pp. 68-70.
(7) Bull. Des M. Acad. Sci. I: pp. 5-57. (1885).
(8) Conch. Exch. 1888: p. 114.
(9) Sci. Amer. Aug. 5, 1899: pp 86-87, w. figs. Bull. U. S. Fish Com. 1898: pp. 289-314, w. 31 pls.
(10) Proc. Ia. Acad. Sci. VIII: pp. 81-84. (1900).

4. *L. fallaciosus* (Smith, 1899) Simpson, 1900.
   Occurs somewhat abundantly in the Wapsipinicon at Independence.
5. *L. higginsii* (Lea, 1857) Simpson, 1900.
   One male example of this puzzling species found in the Wapsipinicon at Independence.
6. *L. gracilis* (Barnes, 1823) Baker, 1898.
   Rare: Wapsipinicon River.
7. *L. ligamentinus* (Lamarck, 1819) Baker, 1898.
   The most common species in the area examined.
8. *L. luteolus* (Lamarck, 1819) Baker, 1898.
   Common to all drainage systems in this section, usually in company with the preceding species.
9. *L. parvus* (Barnes, 1823) Baker, 1898.
   Very abundant locally in the Wapsipinicon at Independence.
10. *L. rectus* (Lamarck, 1819) Baker, 1898.
    Common: Wapsipinicon and Turkey rivers.
11. *L. ventricosus* (Barnes, 1823) Stimpson, 1851.
    A large, almost rayless, ovate form occurs in company with smaller, thinner individuals of this very variable species in all three river systems;—this latter form resembles Call's figure of "*Unio subovatus*" in his paper on the Mollusca of Indiana,* but his figure shows the beaks as angular, a character which he declares constant. In all specimens collected by us, the beaks are evenly rounded. The ovate form seems to be connected by intermediate links with the smaller, broadly rayed form. Very abundant.

GENUS *PLAGIOLA* RAFINESQUE 1820.

12. *Pl. donaciformis* (Lea, 1828) Baker, 1898.
    Wapsipinicon: rare.
13 *Pl. elegans* (Lea, 1831) Baker, 1898.
    Occurs rarely in the Wapsipinicon.

GENUS *TRITOGONIA* AGASSIZ, 1852.

14. *Tr. tuberculata* (Barnes, 1823) Simpson, 1900.
    Very rare: Wapsipinicon river at Fairbank.

GENUS *STROPHITUS* RAFINESQUE, 1820.

15. *St. edentulus* (Say, 1829) Conrad, 1853.
    Not common: Wapsipinicon river.

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* 24th An. Rept. Dept. Geol. and Nat. Hist. Indiana, pp. 335-536, w. plates. (1899).

GENUS *ANODONTA*, BRUGUIERE 1792.

16. *A. grandis* Say, 1829.
   The nacre of the species, which is normally bluish white, is often excessively roughened and salmon colored, a pathologic condition brought about by the work of a parasitic trematode. Other species of *Anodonta*, as well as *Symphynota costata* have been observed as similarly affected. Lea's *A. salmonia* is merely *A. grandis* thus diseased. This species is common to all streams of Iowa.
17. *A. corpulenta* Cooper, 1834.
   Common in the Wapsipinicon and Turkey, usually in company with the preceding species.
18. *A. imbecillis* Say, 1829.
   Collected only in the Wapsipinicon at Independence, where it is common in the slough near the Second bridge. Professor Arey also reports this species from the Cedar River at Cedar Falls.

GENUS *ANODONTOIDES* SIMPSON, 1898.

19. *Ano. ferussacianus* (Lea, 1834) Baker, 1898.
   Occurs in all the rivers of northeastern Iowa.

GENUS *SYMPHYNOTA* LEA, 1829.

20. *S. complanata* (Barnes, 1823) Lea, 1830.
   Very common in the Wapsipinicon and Turkey rivers. In the former stream, the species attains a diameter of from six to eight inches.
21. *S. compressa* Lea, 1829.
   Dead shells referable to this species are found quite abundantly along the Volga at Fayette, but thus far we have obtained no living animals. Keyes gives as the results of his work on the mollusca the following locality: "A few specimens taken in the Des Moines River at Des Moines: very rare."
22. *S. costata* (Rafinesque, 1820) Simpson, 1900.
   Abundant: Wapsipinicon, Volga, and Turkey Rivers.

GENUS *ALASMIDONTA* SAY, 1818.

23. *Alas. calceola* (Lea, 1830) Simpson, 1900.
   Found quite abundantly in the Volga at Fayette and Lima.
24. *Alas. truncata* B. H. Wright, 1898.
   Wapsipinicon, abundant; Volga, at Fayette, a few dead shells found.

GENUS *UNIO* RETZIUS, 1788.

25. *Unio crassidens* Lamarck, 1819.
Occurs rather sparingly in the Wapsipinicon at Independence. Hitherto reported only from the Iowa and Mississippi rivers.

26. *Unio gibbosus* Barnes, 1823.
Represented by numerous specimens from the Wapsipinicon.

GENUS *QUADRULA* RAFINESQUE, 1820.

27. *Qu. coccinea* (Conrad, 1836) Baker, 1898.
Occurs sparingly in the Turkey, Wapsipinicon, and Volga drainage systems.

28. *Qu. lachrymosa* (Lea, 1828) Baker, 1898.
Wapsipinicon: rare.

29. *Qu. plicata* (Say, 1816) Baker, 1898.
Very abundant in the Wapsipinicon. It is found in the Volga, nor have we seen any specimens from the Turkey.

30. *Qu. pustulosa* (Lea, 1831) Baker, 1898.
Wapsipinicon: rather rare.

31. *Qu. rubiginosa* (Lea, 1829) Baker, 1898.
Wapsipinicon: abundant; also found in the Turkey and Volga rivers.

32. *Qu. undulata* (Barnes, 1823) Baker, 1898.
This species occurs not rarely in the Wapsipinicon. It is readily distinguished from the closely related *Qu. plicata* by the greater inflation of the shell and prominence of the beaks in that species. In *Qu. undulata* the shell is rather compressed and the beaks are low.

Independence, Iowa,
May 30, 1910.

New Plants from North Dakota. II.

J. LUNELL.

Gutierrezia Greenei sp. nov.

Radix ligneus longitudine variabilis, plerumque autem brevis, caudice crasso ligneo (uno vel duobus) caules protinus emittente, vel ramis plerisque ligneis e superficie superiore caudicis oriundis, qui caules singulos usque quaternos gerunt. Caules 1-3 dm. alti, herbacei, scabri, in caudice confertissimi,

valde foliosi, praesertim apicem versus. Plantae depauperatae paucos tantum et remotos, plantae autem luxuriosae plurimos et densos caules habent. Folia lineari—lanceolata, in caule 1.5-3 cm. longa, 2-4 mm. lata, in ramis 1.5-2 cm. longa, 1 mm. lata, minutatim punctata, margine ciliolata, apice acuto, colore splendido saturate viridi et quodammodo flavescente. Inflorescentia caulem superiorem occupans ramosa, foliis minoribus foliosissima, ramis eius terminatis in cymo valde contracto, sive plano sive rotundato. Involucra 4.5-5 mm. alta, cylindrica vel nonnihil turbinata, viscida, summa in 3-4 capitulorum glomerulis sessilia, lateralia pedunculata. Bracteae involucri in 3-4 seriebus positae, late lanceolatae, virides vel apicibus viridibus pallidae, obtusae vel acuminatae. Flores pallide vel plerumque saturate flavi. Flores radiati 4-6, flores discoidei 3-5.

The ligneous root of variable length, but mostly short, with one or two thick ligneous crowns directly emitting the stems, or there are several ligneous ramifications from the upper surface of the crown, with 1-4 stems from each of them. Stems 1-3 dm. high, herbaceous, scabrous, densely tufted on the crown, very leafy, especially so upwards. Depauperate plants have only a few distant stems, but well developed plants have very numerous crowded stems, of which I counted 51 in one such plant. Leaves linear-lanceolate, on the stems 1.5-3 cm. long, 2-4 mm. wide, on the branches 1.5-2 cm. long, 1 mm. wide, minutely punctate, with ciliolate margins and pointed upper ends, their color being a deep green, with a yellow tint. Inflorescence branching out from above the middle of the stem, very leafy and with leaves of the small kind, its branches terminating in a very contracted, either flat-topped, perfect cyme, or the peripheral branches perhaps not reaching exactly as high up as the central ones. Involucres 4.5-5 mm. high, cylindrical or somewhat turbinate (becoming so the more in dried plants because the upper part offers less resistance to pressure and is flattened out more than the lower), viscid, the uppermost sessile in glomerules of 3-4, the lateral ones peduncled. Involucral bracts in 3-4 series, broadly lanceolate, green or pale with green tips, blunt or pointed. Flowers varying from a light yellow to a deep yellow color. Rays 4-6, disk-flowers 3-5, there being usually more rays than disk-flowers in a head.

This species belongs to the same group as *G. diversifolia* Greene, and *G. scoparia* Rydb. The former is rather loosely tufted, has an inflorescence of large, turbinate involucres in an open and not flat-topped cyme, and 8 or 10 disk-flowers. *G. scoparia* is larger, having stems often 4 dm. in length, and its involucres are over 5 mm. long and oblong-turbinate.

The plant is common in high, dry, sunny prairie soil in central North Dakota, and its flowering time is August-September. It is one of the few high prairie plants that successfully resisted the drought of 1910. The type was collected at Leeds, N. Dakota.

I deem it delightfully appropriate to name this strikingly beautiful plant in honor of Dr. Edw. L. Greene, the singularly conspicuous landmark in modern botanical history, *princeps ille rei herbariae principum.*

Gutierrezia fulva sp. nov.

Caules 15-18 cm. alti, in caudice perenni, ligneo aliquantulum dispersi, fere glabri, angulati. Folia linearia vel lineari-lanceolata, in caulibus 1-3 cm. longa, 1-2 mm. lata, in ramis 0.5—1.5 cm. longa, filiformia—1 mm. lata, colore pallide et obscure viridi. Inflorescentia cymum apertum, planum vel rotundatum, formans. Involucra 5-6 mm. longa, turbinata, lateralia longe-pedunculata et saepe simplicia, media in glomerulis 2-4 capitulorum sessilia vel subsessilia. Bracteae involucri in 3-4 seriebus dispositae, ovatae, viridibus, obtusis apicibus pellucidae. Flores fulvi, discoidei plerumque 5, radiati 6-8.

Stem 5-18 cm. high, loosely tufted on a ligneous persistent caudex, nearly glabrous, angled. Leaves linear or linear-lanceolate, 1-3 cm. long, 1-2 mm. wide on the stems, 0.5—1.5 cm. long, filiform—1 mm. wide on the branches, of a rather dull, dark green color. Inflorescence in an open, flat—or round-topped cyme. Heads 5-6 mm. long, turbinate, the peripheral long-peduncled and often simple, the central sessile or nearly so, in glomerulis of 2-4. Bracts of the involucre in 3 or 4 series, ovate, hyaline with green, obtuse tips. Flowers deep yellow. Disk-flowers usually 5, rays 6-8.

The species belongs to the same group as *G. diversifolia* Greene, which has rays 5 or 6, disk-flowers 8 or 10, *G. scoparia* Rydb., which is larger in all its parts, has lanceolate outer bracts and oblong- turbinate involucres, and *G. Greenei*, which is densely tufted and has a strikingly different color of its foliage, contracted inflorescence and rays and disk-flowers numerically different.

The plant grows on dry, sunny hills or hillsides and was collected on August 28, 1908, by the writer at Des Lacs, Ward County.

Achillea lanulosa Nutt. var. **arachnoidea,** var. nov.

Caulis laxe arachnoideus. Folia caulina 15-28, stricte vel laxe sericeo-pubescentia.

Stem loosely arachnoid, stem leaves 15-28, appressedly or loosely silky pubescent.

In woodland thicket, Turtle Mountains, N. Dak., July, 1910.

Plantago major L, var. luxuriosa, var. nov.

Planta luxuriosa, folia erecta, 7-11 nervata, late ovato-orbicularia, apice retuso et basi rotunda vel cordata, amplissima 12-14 cm. diametro, petioli lati et canaliculati, scapi erecti.

Plant exuberant, leaves upright and 7-11-nerved, broadly ovate-orbicular, with obtuse apex and round or cordate base, the largest 12-14 cm. in diameter, petioles broad and channeled, scapes erect.

In low meadow land of the Turtle Mountains, N. Dakota, near St. John, July, 1910.

Salicornia rubra A. Nels., var. prona var. nov.

Planta ramosa, et rami fundum petentes.

Profusely branched. and the branches bent down towards the ground.

In saline soil, Devil's Lake, North Dakota, collected on August 18, 1910.

Helianthus nitidus sp. nov.

Perennis. Rhizoma crassum, tuberosum. Caulis 6-10 dm. altus, in parte superiore ramosior, strigoso-pubescens apicem versus, ceterum glabratus, saltem aetate. Folia splendide viridia, oblongo-ovata, 6-10 cm. longa, 3-5 cm. lata, coriacea, juxta basim 3-nervata, in caule breviter petiolata, in ramis sessilia vel subsessilia, serrata, in lamina superiore scabra, in lamina inferiore strigoso-tomentosa, capillis strigosis longioribus in nervis operta, superiora quidem basi abrupte contracta, alterna vel opposita, inferiora basi angustata et opposita, nonnumquam omnia vel nonnulla in tribus verticillata. Petioli paulum alati, marginibus ciliatis, partim amplectantes, inter oppositos sicut connati. Involucra 3-5 cm. diametro, numerosa. Bracteae involucri lanceolatae, lamina et margine inferiore ciliis longis, albis praetexta, margine autem superiore breviter ciliata. Flores radiati 13-20, 1½ cm. longa, 7 mm lata.

Plant with a fleshy, thick, perennial tuber-bearing root stock. Stem 6-10 dm. high, very much branched above, stri-gose-pubescent in the upper part, else glabrate, at least in age. Leaves bright green, oblong-ovate, 6-10 cm. long, 3-5 cm. wide, leathery, 3-nerved near the base, on the stem short-petioled, the branches sessile or nearly so, serrate, scabrous above, stri-gose-tomentose beneath with longer, strigose hairs on the veins, the upper alternate or opposite, abruptly contracted base, the lower opposite, narrowed at base; sometimes all or part of the leaves are verticillate in 3's. Petioles somewhat winged, with ciliate margins, partly clasping, somewhat connate when the leaves are opposite. Heads 3-5 cm. in diameter,

numerous. Bracts of the involucre lanceolate, long-acuminate, spreading, in two series, or all having nearly the same length, with long spreading white hairs on the margin and the surface of the lower half, on the upper margin short-ciliate. Rays 13-20, 1½ cm. long, 7 mm. wide.

This species is related to *H. tuberosus* L., which is larger in all its parts, with long-petioled leaves; its rays are 3 cm. long, 1 cm. wide.

The plant grows in rich, moist soil in ravines or other protected localities in central North Dakota, and the type was collected by myself at Butte, N. Dakota, on August 5, 1906.

Helianthus nitidus var. **camporum,** var. nov.

Lamina folii inferior scabra.

Leaves scabrous beneath.

Not rare on the open prairie. Collected at Leeds, on Sept. 8, 1910.

Helianthus apricus sp. nov.

Perennis. Rhizoma crassum, tuberosum. Caulis 6-7 dm. altus, scaber, apice albo-strigoso, simplex vel in axillis superioribus sparsim ramosus. Folia lanceolata vel anguste ovato-lanceolata, firma, plana, lamina superiore scabra, inferiore albo-strigosa, juxta basim 3-nervata, extremitatibus ambobus angustata, apice acuto, breviter petiolata, marginibus tumescentibus serrulata, 2-7 cm. longa, 5-22 mm. lata (relatione plerumque 3:1), opposita vel superiorum 1-5 alternata. Petioli cauli proxime ciliati, inter oppositos quasi connati. Involucra solitaria vel pauca, 5-6 cm. diametro. Bracteae lanceolatae, longe acuminatae, divaricatae, conferte pubescentes, margine inferiore ciliis longis, albis vestitae. Flores radiati 15-20.

Perennial, with fleshy, thickened, tuber-bearing rootstocks. Stem 6-7 dm. high, scabrous, white-strigose at the top, simple or with few branches in the upper axils, and one head at the end of each branch. Leaves lanceolate or narrowly ovate-lanceolate, firm, flat, scabrous above, strigose white-hairy beneath, 3-nerved near the base, narrowed at both ends, with acute apex, short-petioled, serulate with thickened margins, 2-7 cm. long, 5-22 mm. wide, usually in the proportion of three times as long as wide, all opposite or 1-5 of the uppermost alternate. Petioles ciliate at the proximal end, somewhat connate when opposite. Heads single or few, 5-6 cm. in diameter. Involucral bracts in two rows, lanceolate, long-acuminate, spreading, with appressed pubescence, and margined below the middle with white, long, spreading hairs. Rays, 15-20.

Among related plants *H. subtuberosus* Bourgeau, has leaves narrowly lanceolate, scabrous beneath and four times as

long as wide, with densely pubescent and white-ciliolate bracts, and *H. Maximiliani* Schrad, has dull green, pinnately veined conduplicate, elongated lanceolate leaves, about 6 cm. long, 16 mm. wide, or in that proportion, and involucral bracts in four series (this last character is hardly noticeable except on the living plant).

The species grows in dry soil on the open prairie in central North Dakota. The type was collected by myself at Leeds, on September 10, 1900.

Leeds, North Dakota.

The Name of Our American Wax Bayberries.

J. A. NIEUWLAND.

Quite a number of botanists more or less recent and others even generations ago have come to the conclusion that the Linnaean aggregate genus *Myrica* like so many other of his composite groups to which he applied the name genus, should be split up, not only for convenience but to show proper phytological relations. The European bayberries had been called *Gale* first by J. J. Bauhin in 1650, and nearly all botanists after him, Tournefort included, accepted the name without hesitation. Linnaeus, however, whatever other reasons he may have had for not liking the name, rejected it because it was not of Latin origin, and to make the confusion worse gave the bereaved plants the name *Myrica*, which for centuries by botanists, and still by common people where the plants grow, had been used for what Linnaeus called *Tamarix*, from *Tamariscus*. Such wanton transfer and changing of well-grounded and well-established names seems to have been a very favorite amusement of Linnaeus, and not a few of these nomenclatural piracies are unhesitatingly accepted by botanists now who hold that 1753 is the beginning of botanical nomenclature, if not botanical science as well.

In looking through the old English herbals of Parkinson* and Gerarde† one cannot but help seeing, even if only superficially acquainted with the *Species Plantarum* of Linnaeus, that this author obtained some good ideas from the two Englishmen, which have perhaps been unthinkingly accredited as original with the eighteenth century botanist. Though Parkinson and Gerarde can not perhaps be said to have used many

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* Parkinson, J. Theatrum Botanicum, 1640.
† Gerarde, J. The Herball or Historie of Plants, 1597.

more binary plant names proportionately than Dodonaeus, Camerarius, Thalius or Matthiolus, still the arrangement of such names in separate headings, is so striking to the eye, and the names so much resemble the Linnaean trivial names, that one can hardly help thinking that the Swedish botanist had very carefully studied the English herbals and considered their ideas of trivial names, (not at all original with them, however,) as worthy of being followed. Scores of such names could be brought forward perhaps to show that Linnaeus was much influenced by Parkinson and Gerarde, just as the latter were influenced by or even bodily copied from Clusius Dodonaeus, Tragus and Fuchs. This fact seems all the more striking when we find that Linnaeus copied even the mistakes of the other authors.

It appears that both Gerarde and Parkinson substituted *Tamariscus* for the Theophrastan names *Myrica*, whereas, the former name, if mentioned at all, was only given as a synonyme by other older botanists. Linneaus followed the Englishmen in using the synonyme for the valid name and then thought himself free to apply the displaced name *Myrica* to any group of plants he wished. I can find no other reason why Linnaeus should have caused this confusion, though it is to be questioned whether it is worth while to try to investigate the changes of names made by him, as so many appear as deliberate and wanton robberies. This may, however, explain, if explanation is worth while, why assuming the wrong name for the Tamarisk and finding the name *Myrica*, a synonyme, he felt himself free to apply it to anything he wished, therefore, why not to the bayberries. He thus made two blunders at once, the first in depriving a plant of its older and more commonly used name even in his time, and the second mistake in using that name as a substitute for another well established and unobjectionable name of yet another plant group.

One would think that assuming 1753 as the beginning of nomenclature this confusion could not have been perpetrated, but as we shall see the post-Linnaean confusion of names is worse perhaps than that caused by the Linnaean blunder, caused too by the appeal to the same principles as prompted Linnaeus.

Small, in his *Flora of the Southern States*, on the assumption that our American plants are generically different from the European plants, the type of the *Myrica* of Linnaeus and the *Gale* of Tournefort and J. Bauhin, separated them, and used the oldest synonyme of a segregate genus, that of *Morella* of Loureiro, 1790. Dr. Greene has shown that the *Morella* of Loureiro had for its type a Cochin-Chinese plant as distinct,

if not more so, from our American plants generically, than the latter are from *Gale* Tour., 1703, or what is the same, the *Myrica*, Linn., 1737 and 1753.

Mr. I. Tidestrom, in his *Elysium Marianum*,* also distinguished the two genera by different names. He rejects the *Gale* altogether as not being a Latin name, for the same reason that *Hondbessen* and *Gansblum* of Adanson have been universally rejected in spite of their priority. The name, he says, comes from the Belgian or low Dutch *Gagel* as J. Bauhin intimates. Mr. Tidestrom gives the European plant the name *Angeia*. Dr. Greene† maintains, however, that *Gale* is admissable, as a Latin two-syllabled word, whose origin, moreover, is said to be rather from the English Gaule or Gale, saying too, that as a latinized word it was not objected to for etymological reasons during 250 years, and even after Linnaeus' attempted suppression, the word was restored by several authors, one as late as 1902.

Mr. Tidestrom gives to the American bayberries the new name *Cerothamnus*. Dr. Greene* remarks in this connection that "as regards the new name, *Cerothamnus* for the Bayberry shrubs and trees it seems as if some statement ought to have been made of the reason for ignoring Rafinesque's name *Cerophora*.†" Dr. Greene finds, however, that Rafinesque, like Linnaeus, transposed the plants, (or rather types in this case), and this in such a way that there is a complete uncertainty about the application of Rafinesque's name. He apparently presumes to make our American plants the type of the Linnaean genus and calls it *Cerophora*, a proceeding thus far parallel with that of Salisbury's blunder in giving the type of the genus *Nymphaea* of Linnaeus a new name, *Castalia*, and leaving *Nuphar*, the yellow pond lilies, the name *Nymphaea*. The analogy is not perfect, however, for though Rafinesque apparently left the American bayberries under *Myrica* Linn., yet the confusion is more inexplicable as some of our native species seem to be left under both names. Rafinesque, too, it would seem, wished to get rid of the name *Gale* at any cost. Dr. Greene concludes: "As for the real *Cerophora* and its applicability, the first lines of Rafinesque's paragraph indicate his purpose to have been mainly that of being rid of *Gale*, which he says is Dutch, whereas, in truth it is English. But, passing from the consideration of the name *Cerophora*, as a substitute for the Linnaean *Myrica*, to what particular

* Tidestrom, I. Elysium Marianum. Washington, 1910. p. 41.
† Greene, E. L. Leaflets of Botanical Observation, Vol. II, 1910. p. 102.
* l. c. p. 103.
† Rafinesque, C. S. Alsographia Americana, pp. 9-12, (1838).

type does the new name apply. When the author immediately after the name cites *Gale*, Tournefort, as its equivalent, we seem compelled to regard *Myrica Gale*, Linn., as its type; but, yet, the very name *Cerophora* seems to contradict that; for the gale shrub is not wax-bearing. And the thought is contradicted again when, proceeding to the two subgenera of *Cerophora* he plainly makes our exclusively American wax-bearing shrubs the typical subgenera.

There must then forever remain two opinions as to the tenebility of *Cerophora*, Raf., and I find myself at accord with the author who has proposed the new name *Cerothamnus*.*"
At this stage it would seem that there is a great deal of room for quibbling about the tenebility of Refinesque's name in spite of the perplexing confusion of his types and names, and botanists might hope to assume or reject it with a certain show of reason, unless they do as Dr. Greene and Mr. Tidestrom have done, i. e., consider *Cerophora* as a confused doubtful application, and so reject it altogether on that account alone; for a publication of a name must be clear and beyond shadow of doubt.

I find, however, that a fortunate circumstance comes to our assistance in unravelling the tangle, and solves the difficulty for all time as far as Rafinesque's name is concerned, so that there need not forever remain two opinions as to the tenebility of *Cerophora*: for the *Cerophora*, Raf., 1838, as a name for any group of bay-berries is a homonym of over thirty years standing. In fact, what is more remarkable about the matter, is that the first *Cerophora* of 1808 was applied by Rafinesque himself to a genus of fungi. In the *Medical Repository* of 1808* he had proposed the name for a new group of fungi, and the name had actually gotten into quotation in Steudel's Index.

It is not necessary to attempt to explain how Rafinesque, who was forever criticising his contemporaries for using homonyms or synonyms could have so far forgotten himself as to reduce names of his own making to the role of homonyms, unless he held in this case, as he was known to have done in other similar instances, that an author of a name may change it at will, or even replace it. I shall also leave it to the mycologists to determine what the first *Cerophora* may be, still it may not be amiss to give the short paragraph of Rafinesque in full, and let others judge as to the validity of *Cerophora*, Raf., 1808.

"Cerophora, (clavata, globosa, pyriformis, thamnioides, [illegible]oma, fastigiata, minuta, etc.) is a fine new genus akin

* The Medical Repository, 2nd Hexade, Vol. V, p. 355, (1808).

to *hydnum*, but the fructification is in horn like terminal papillas. Found in different states." *

Steudel mentions only two species of *Cerophora, C. clavata* and *C. capitata*, and refers both to Rafinesque, though the latter is not found in that author's list. †

A review, or rather a mere translation of the above mentioned diagnosis of Rafinesque's *Cerophora* of 1808, found its way into the *Journal de Botanique, Tome II, 1809, p. 176*. As it seems but a French rendition of the original no further note of it is of interest.

In still another work of Rafinesque printed by the author at Palermo in 1814.* another reference to the fungus genus *Cerophora* is made. The characters seem somewhat more clear, and it is evidently the publication of the genus that came to the notice of Steudel just referred to. It may be of interest to give the text completely as the work of Rafinesque is very rare.

("G. *Cerophora.*

Peride sessile on stipité, simple ou ramifie, fructification superieure en forme des petites cornes ou pointes solides.

Obs. Ce g. ne diffère presque de l' *Hydnum* que par sa fructification superieure, et de l' *Hericium* que par ses pointes dures et laches.

174. *Cerophora clavata* peride en massue cylindracée entierement convert de pointes. *Dans le N. Jersey.*")

175. *Cerophora capitata*. Stipité, péride sphèrique entierement convert de pointes. *Dans le N. Jersey.*

Mr. Tidestrom's name *Cerothamnus* is then the only and oldest one for our segregated American wax bayberries, and there can not possibly be any quibbling about Rafinesque's name *Cerophora* of 1838. I shall briefly give a resumé of the synonymy of the two genera.

1. GALE, J. Bauhin, 1650,* also Tour, 1703,† Duhamel 1755,‡ and Adanson 1763.§

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* Med. Rep., (1808) l. c.

† Steudel, E. Nomenclator Botanicus, Plant Crypt. (1822), p. 113.

* Rafinesque, C. S. Precis des Decouvertes et Travaux Somiologiques entre 1800 and 1814. Palerme. Royale Typ. Militaire 1814. Aux depens de l' autre.

* Bauhin, J., and Cherler, J. H., Historia Plantarum, pars. 2, p. 224. (1650).

† Tournefort, J. P. de, Act. Acad. t. 3, (1703).

‡ Duhamel du Monceau, Traité des Arbres et Arbustes, t. 1, p. 253. (1755).

§ Adanson, M., Familles des Plantes, 2nd part. p. 345, (1763).

(*Myrica*, Linn., 1737 and 1753.‖)

(*Cerophora* (?) Raf., 1838,** not *Cerophora*, Raf., 1808.††)

(*Angeia*, Tm., 1909.§§)

2. CEROTHAMNUS, Tm., 1909.§§

(*Morella*, Small, 1903,¶¶ not *Morella*, Lour., 1790.‖‖)

(*Cerophora* (?) Raf., 1838,** not *Cerophora*, Raf., 1808.††)

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Pteridium, J. Agardh, A Homonym.

J. A. NIEUWLAND.

J. Agardh* in segregating *Delesseria alata* as the type of a new genus, *Pteridium* from the other delesserias, seems to have forgotten that the name *Pteridium* had been used by Scopoli in 1760†, for the new genus founded on the Linnaean *Pteris aquilina*, or common bracken. The genus of Scopoli called *Thelypteris* before Linnaeus has lately become again recognized as a valid one, and it certainly seems to be entitled to distinct generic standing from *Pteris*. Even Theophrastus accepted it as such and the name, *Thelypteris*, for the common bracken originated with him, a name which on the basis of absolute priority is the correct one. The custom of not accepting names prior to 1753, however, has caused much confusion, and this is but a minor instance of the kind. Until 1753 be obragated as a

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Linnaeus, C., Genera Plantarum, no. 746, p. 302, (1737).

Linnaeus, C., Species Plantarum, p. 1024, (1753).

* Rafinesque, C. S., Alsographia Americana, pp. 9-12, (1838).

Rafinesque, C. S., Medical Repository, p. 335, (1808).

Tidestrom, I., Elysium Marianum, 1910, p. 37.

Loureiro, J. de, Flora Cochin-Chinensis, p. 548, (1790).

Small, J. K., Flora of the Southeastern United States, p. 337, (1903).

Agardh, J. G. Spec. Gen. Ord. Alg. Vol. 3, Pars. 3, p. 218. Genus Lundae (1898).

† Scopoli, J. A. Flora Carniolica, 1760, p. 169.

"Starting point" of our nomenclature, the *Pteridium* of J. Agardh is a homonym.

Some of the species of the genus are:

(*Pteridium* (Kutz.)‡ J. Agardh, not of Scopoli.)

(*Pteridium*, Kutz.) as subgenus in *Hypoglossum*.‡

(1) *Pteridium alatum* (Hudson) J. Agardh.

Fucus alatus, Hudson.

Delesseria alata (Hudson) Lamour.

(2) *Pteridium spinulossum* (Ruprecht) J. Agardh.

(3) *Pteridium Juergensii*, J. Agardh.

(4) *Pteridium Baerii*, Ruprecht.

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‡ As subgenus under *Hypoglossum* Kg.
Kutzing, F. G. Species Algarum, 1849. p. 877, also
Kutzing, F. G. Phycologia Generalis, 1843. p. 445.
As subgenus under *Delesseria*.
Agardh, J. G. Spec. Algar. 2. p. 683. (1852). Vol. 3. p. 483 (1876).
Harvey, W. H. Ner. Bor. Am. 3, p. 94 (1853).

ERRATA.

Page 198, line 4, for *Viola Lunellii*, read *Viola subvestita*.

" 207, insert between lines 25 and 26: Spicae laterales 1-2.5 cm. longae, angustatae, et spica quidem.

" 207, line 27. Strike out this whole line.

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Certain Aspects of the Species Question.

BY EDWARD L. GREENE.

Some months ago, while endeavoring to reduce in some degree the confusion of an overladen and disordered work table, I found one corner of it occupied by a formidable stack of pamphlets most of which I had wished and meant to read, yet none of which I had seemed to find time to peer into. Attempting to assort these, I came at length upon one most inviting looking blue-paper-covered brochure, something about which constrained me to pause and rest awhile, and read.

Opening at random this fair document, my eyes fell on this caption: "The Taxonomic Aspect of the Species Question." I could not at first read much beyond the title itself, it seemed to me to be such a remarkable one, and so ill devised, so pleonastic; for two out of four of the terms of it appeared to me to be redundant. Inasmuch as species are in their very essence taxonomic units, one cannot touch the subject of species without immediately involving himself in the subject of taxonomy. The species idea, and taxonomy, so long as species are considered from any standpoint not wholly unscientific, seem absolutely inseparable. If I am right in this, I said to myself, then this title would have been improved had it read simply: The Species Question, for the taxonomic is unmistakably implied in that, and to have written it out was to write a needless word, and the filling in of useless words makes bad writing. These were the reflections that followed my mere glance at the first title to which I came, as I opened the pamphlet; and before reading I began looking to see what the other titles were. Going back to the beginning, I found that the very first caption was precisely the same as that second one, the one which by chance had been first to claim my attention; and as I went

* December 1, 1910.—Pages 245 to 267.

on, I read in regular sequence the captions following: The Physiologic Aspect of the Species Question; The Physiologic Aspect of a Species; An Ecologic View of the Species Conception; An Ecologic Aspect of the Conception of the Species; and having viewed these several titles in line, and noted that unity in diversity which they evince, I saw how the taxonomists in deference to the titles chosen by the physiologist and the ecologist, had been obliged to introduce a corresponding modifier into their own title. They had courteously waived their rights as the sole real custodians of the Species Question, and had inserted terms by which, what would have been their own simple rightful caption became a distorted pleonasm. It was done out of courtesy, and is on that ground excusable and excused.

But am I to be excused by my friends physiologic and ecologic for having seemed to deny them any right in the subject of taxonomy? I shall be, when once they have understood me. If any one of these by his researches physiologic or ecologic comes upon new facts seeming to bear on taxonomy, and he make the application, or suggest, even, its taxonomic usefulness, he is in that become, for the time, a taxonomist himself.

But that which is of unusual interest in this Report of the Symposium is an aspect of the species question not named in any of the formal papers,—indeed not named at all—but which one detects in the reading of the reports of the informal discussion which is said to have followed the presentation of the titled papers, and which appears to be as far removed as possible from the scientific; even disclosing itself in a guise which leads one to question whether it may not well be designated the industrial aspect of the species question; though that may perchance be seen, by and by, to be too lax and indefinitive an expression to be employed. The most entertaining thing about this particular viewpoint is the proposal that in genera where species are thought, from whosesoever point of view is not stated—to be inconveniently numerous, there shall be a kind of enforced reduction of the number, and that by what threatens to be made a merely arithmetic rule. There was even a suggestion of the probable proportion of two-thirds of the species, and this suggestion met with warm approval from at least one corner of the symposium. Such suggestion, should it be adopted as a rule to proceed by in this arbitrary reduction, would work in this way. If, for example, within the last dozen years Mr. Fernald

and I have published for the region of Gray's Manual a dozen species of *Antennaria* where all former editions of that book had but one species, eight of our new ones must be relegated to non-entity, and only four be permitted to figure as valid; this number of four, we venture to suppose will have been estimated as a large enough increase of the number of antennarias over the number of one species recognized twenty years since. Again: if I alone have published for the United States and Mexico 45 species of *Ptelea*, where formerly 5 only had been accredited, I am warned beforehand that by this arithmetic gauge of taxonomic values 30 of my *Ptelea* species will be invalidated and 15 out of 45 may stand that strange and wonderous test and be approved. The question how these reductions are to be accomplished does not appear to have been broached by any one of the two or three members of the symposium who suggested and with more or less enthusiasm advocated the arithmetic scheme. Presumably the selection will be made by lot. That would be in perfect keeping with the principle advocated; though possibly some other alternative would be resorted to, by which to show favor to such "recklessly made" species as the foremost and most willing if not ardent supporter of arithmetical suppression himself aforetime perpetrated. By way of illustrating what I mean, I shall call attention to the fact that much less than a generation ago the admitted pecies for the genus *Eryngium* in North America numbered 15. At present they number 30, and for this recent doubling of the number of species in the genus Mr. Coulter is mainly responsible. Two or three other authors have contributed barely, or scarcely, one new species each to this increase, while for 11 of them our main supporter of suppression by arithmetic rule is sponsor.

Yet again, in that earlier time which is not long ago, to the group of plants then called *Peucedanum*—afterwards within a little space twice changed, first to *Lomatium*, then to *Cogswellia*—there were attributed some 25 North American species; then all at once, as late as the year 1900 the membership of the genus was more than doubled, and that not only by consent of our species-fearing friend, but by his most active support; for, out of these now 60 species most of the 35 new ones are owned by him as his. And these are but examples selected out of considerable number in which our most strenuous supporter of the arithmetic reduction

scheme, will have to apply the process to his own work, provided such general suppression of recent species be taken in hand.

I have been more explicit than I had intended to be in open animadversion on this aspect of the species question; but I saw the desirability of calling forth this strange suggestion from its lurking place in the symposium report, and setting it before another class of readers for their enlightenment as to what curious things are being thought and spoken in relation to species; and no one, I think, will have the hardihood to undertake the defense of those propositions as even remotely verging toward the scientific. Probably nothing more dogmatic and arbitrary ever before found expression, and at the same time was let pass uncriticized, in a symposium of men professedly scientific.

I have already referred to this unscientific outlook on the species question as the industrial one. Possibly it may prove susceptible of a more definitive or diagnostic name. Let us see. I do not recall that the scheme of arithmetic species-reduction had advocacy in the symposium save on the part of such as are known to be individually interested in copyrights on books of descriptive botany; and this is in all probability more than a mere coincidence; any way, I have long seemed to see that there is often taken, however disguisedly, what I will designate now as the Bibliopole Aspect of the Species Question.

It is evident that if good profits are to accrue from botanical manual copyright, two conditions must be met. The book must profess to cover an area of well peopled territory sufficient to invite many purchasers. Then the cost of the printing must be so incondiderable that the book may be offered at a moderate price. Of course the expense of publication is determined by the number of pages printed; and so one, and perhaps the most inexorable, of the conditions of a volume of descriptive botany that is to *pay generously* will be that the number of species to be described be reduced to a low figure. The smaller the number of species the less the cost of printing and the more lucrative the investment, so long as the extent of territory embraced, and thereby the prospective large sales, remain the same.

By way of illustrating how a single genus, according to the treatment given it, may increase or lessen at once the cost of printing a manual, and the profits on copyright in it, let us consider *Crataegus*. It is well known that, by recent investigation

that has been carried on by a considerable number of botanists, it has come to pass that, where the last generation of manual-makers had less than a dozen species for the whole of the United States and Canada, those of to-day are confronted by nearly a thousand that have been formally named and published within about twenty years; most of them, too, with diagnoses—not a few of them with illustrations—that in general seem to bespeak valid species, however astounding to us conservatives the fact may seem.

And now, what is the aspect of this crataegus question from the book-sellers point of view? Suppose that good descriptions of 10 species, printed in the type usually selected for manuals of botany, fill two pages, the printing of which costs $4.00, then diagnoses of 100 species will fill twenty pages and cost $40.00, and 900 species would cost $360.00. Now if the more than 900 North American kinds of *Crataegus* which most reputable botanical gentlemen stand sponsors for, and whose validity they are ready to defend, can by hook or by crook be reduced in number by two-thirds, then the cost of printing *Crataegus* for a North American Flora will fall from $360.00 to $120.00; and so, if I figure correctly, it looks as if, upon my hypothesis as to printers' bills, the neat sum of $240.00 might be added to the profits of copyright on the score of this one genus alone, by the copyright owner who can reduce the now existing catalogue of its American species by two-thirds. And this illustration which I make by this extreme case of *Crataegus*, throws light enough upon the whole affair. If some hundred of smaller genera, such as are credited with but a tithe of 900 species, can one after another be cut down in said arithmetical proportion, the reduction of their species will of course in the same way augment the profits in copyrights.

There have been generations of good botanists who lived peaceable and comfortable lives, also in the enjoyment of tidily remunerative copyright in manuals, all undisquieted—or at least seldom and not deeply disturbed—by the species question.

Away back in the year 1848 there was no great dearth of manuals of descpritive botany for the northern United States. Amos Eaton's Manual had gone through eight editions, and Wood's Class Book has appeared in a tenth edition. In this year there came forth a new Manual of Botany of the Northern United

States, issued by a good publishing house in Boston. The territory embraced by this first edition of Gray's Manual extended from Maine to Wisconsin, and far enough southward to include Pennsylvania and Ohio. In an exceedingly well written and instructive Preface we meet with the statement that it has been "firmly intended to restrict [the book] to 350 pages;" and here we seem to have intimation of a requirement of the publishers that the pages of this Manual must be few. They were, like publishers in general, apprehensive that too many pages would reduce the profits; and what troubled them in this instance was—had they but known the real name of it—the species question.

But this initial edition of Gray's Manual—by much the most handsome, as well as scholarly in its substance and make up of all the editions—came out in more than twice the 350 pages, and was a remunerative enterprise nevertheless. And now, in order to show how serenely ,and during half a lifetime, the author of Gray's Manual escaped the troubles of the species question, a comparison of some sort must be made between the taxonomic contents of this first edition of 1848, and the sixth edition of 1889. To accomplish this it is only needful to make selection of several representative genera of higher plants, and contrast the number of species attributed to each such genus in those two different editions the dates of which indicate an interval of 41 years.

	1848	1889
Antennaria	1	1
Arabis	10	9
Cnicus	10	8
Crataegus	7	10
Eupatorium	13	16
Hieracium	6	6
Potentilla	19	14
Rubus	10	11
Solidago	32	42
Viola	17	17

These figures, as I have with care studied the genera as they appear in the two books, have proven an astonishment even to myself; for, while from my very boyhood forward to early manhood I had heard it said that the author of this manual was dogmatic, and intolerant of any questionings of his own infallibility on the species question, still, after all the years, I was not yet so

fully convinced as the above mentioned and other comparisons have convinced me, of the absolute stagnation of botany in the Eastern and Middle States during the forty years and more of this author's unbroken rule and acknowledged sovereignty.

One of the interesting points, as to the condition of botany during those long years, is that in certain genera there was even a reduction of the number of species, and this despite the circumstance that the territory covered by the manual had been notably increased. And if *Eupatorium* and *Solidago* show a slight increase, this is solely because certain southern states—the South is rich in species of this genera—had been annexed to the manual area.

Now it was not at all held as a secret by the author of this series of manuals that the copyright on them was about his best source of income. I myself have heard him say it. It also appears that in this first edition of the work, the one which he had hoped could be made a good one within the limits of 350 pages, but which grew to pages 696—in the preparing of it, I say it appears that he had been most unsparing of the published species of his most eminent predecessors and contemporaries. I doubt not he may be found to have suppressed in the aggregate some hundreds of the species of Michaux, Pursh, Nuttall, Rafinesque, Muhlenberg, Eaton, Dewey, and almost all those of his Bostonian neighbor, Jacob Bigelow, than whom in my judgment, no one then living in New England had better native abilities as a botanist. And this reckless overruling of his contemporaries—many of whom had field knowledge of northern botany to which he never attained or even aspired—this dogmatic suppression of others' works, supported by that well deserved prestige which his Flora of North America had gained for him, together with that influence which high professional station exerts over the whole multitude of amateurs and aspirants—all these conditions together brought about the period of botanical stagnation which is now well recognized as having existed during long years.

The dormant period of East American botany had been brought to an end some years before the appearing of the very latest edition of Gray's Manual; and as the author of the first edition sixty years before, as prospective bibliopole, had found himself confronted by the species question, so, and also under pressure of bibliopole considerations, did the editorship of the newest edition find itself face to face with the same difficulty, and that in an ex-

aggerated form, as well as under conditions much less favorable to a dogmatic and imperious solution of the problem than those which had existed sixty years before. The first editorship had been vested in a single individual, a man already of reputation, and that also well earned, in his chosen field, gifted with insight and in his laying siege to species singularly favored by circumstances. Of his elders and his contemporaries who had published so many species, almost all had disappeared from the field; some as having been claimed by death, others as having abandoned botany. He was even a professional botanist more than his predecessors, and occupied a seat of authority. Everything conspired to warrant his assuming, for North America, the imperium of the science. It required no great degree of courage to assume it; and his imperium was long a success. His task was easy. There was not at the time, a journal of botany in existence, nor any danger from open criticism or protest. Of those expensive abstractions, species, he suppressed as many as he would, and then for almost forty years, enjoyed the remunerative and the peaceable fruits of his early conquest. How, and by what forces, this imperium came to an end need not here be told. The important fact is that it had ended a full decade of years before the latest issue of Gray's Manual was undertaken; and species had multiplied amazingly beyond all that any one forty years earlier could have dreamed; and the editing of the new manual involved difficulties impossible to have been anticipated. With what indifferent results compared with those reached sixty years before, the new editorship has met the species question, may be intimated by presenting again a column of sample genera; a list of generic names in good part the same as that given above, but showing figures for the three editions of the Manual, the first, the middle edition and the latest.

	1848	1889	1908
Antennaria	1	1	11
Carduus	10	8	15
Cratægus	7	10	65
Eupatorium	13	16	19
Galium	10	13	25
Hieracium	6	9	17
Houstonia	5	6	11
Juncus	20	27	44
Lechea	3	5	8

Lonicera	8	9	15
Panicum	19	23	83
Paspalum	2	8	21
Potentilla	9	14	21
Rubus	10	11	38
Scirpus	14	17	35
Senecio	3	8	18
Sisyrinchium	1	2	13
Solidago	32	42	56
Vernonia	2	6	8
Viola	17	17	45

Perhaps a selection of figures statistical like the above does of itself sufficiently emphasize the failure I had intimated; the the manifest inability of the aforesaid editorial people to suppress the swarming multitude of recent botanical species. To suppress such by the hundred would have seemed the bounden duty of new editors in view of their having chosen—perhaps by forceful considerations having been constrained to use— the name of that great conservative who was so intolerant of species and species-makers. I am confident that the author of the first Gray's Manual could he have had in dream or vision of the night a view of the three columns of figures written above, realizing that those of the right-hand column were exactly prophetic—a real enumeration of the species that were to be admitted in a book of the not distant future and to be audaciously named "New Gray's Manual"—not only would he have arisen from such a vision in a rage; he might have lived thereafter to his life's end in dismal apprehension of a reincarnate Rafinesque, coming with power to beget speedily a numerous and full-grown progeny.

It must not be assumed by the reader that the genera cited are in all cases indicative of sudden increase by accession of so many new species. *Hieracium*, for example, had in 1848 6 species, all native; and the 3 more that find place in the book of 1889 are all Old World species that had added themselves to our flora by naturalization. Also the increase from 9 in 1889 to 17 in 1908 is mainly attributable to the same cause; for now 7 out of the 17 species are introduced, 1 only having been added to the aggregate of species as new. *Carduus*, or *Cirsium*, or by whatever name you call the genus of the thistles, as well as *Galium* and *Senecio* have of late been more or less notably increased in the number of their

species by the same circumstance. *Lechea* I have written into the list of selections partly because that genus figures as perhaps the very first to have been seriously and critically investigated, and to its increase of species, while as yet Asa Gray at least with respect to eastern botany was holding the imperium. It is also worthy of note that the amateur, Mr. Leggett, who had been so successful in his researches in *Lechea*, had hardly gathered courage to publish his results, and the publication of them was made by bolder men after the demise of the investigator. I observe also that, beyond all doubt in my mind, the species of *Lechea* in the edition of 1908 ought to have been 10 rather than 8, the editorship having reduced two of a New York botanist's species which, from their original characterization, seem as valid as any of the other five that came into their places late, and are recognized in the new book as good.

But, of entirely another category than that to which *Cirsium*, *Hieracium*, *Senecio* and *Lechea* belong are most of the genera listed above, in that the sudden and great increase of them in species which my figures indicate—a simply enormous increase in the cases of *Antennaria*, *Cratægus*, *Panicum*, *Rubus* and others—has come about solely by an accession of new species, all established within much less than twenty years; most of them within twelve or fifteen. I say established because the editors of the new book concede that all the species—in whatsoever newly expanded genus—which they have admitted, are valid species; such as they themselves have passed their supreme judgment on, and that favorably. Here are their words: "The present editors have considerably delayed the issue of this work in order to examine these new propositions and give them recognition in all cases where their merit could be demonstrated. In a few instances, however, it has been impossible from lack of material or data either to include as valid or to reduce definitely to synonymy such species and varieties, and it has accordingly seemed best not to mention them. It is not thereby meant that they are not of value, but merely that evidence of their distinctness has not been available."

Now from this pronouncement, and the explanation, which together read so open-mindedly and fairly, one need not overlook certain curious logical inevitable conclusions that follow.

There is in Massachusetts a seat of high judgment on all matters of systematic botany, a court of final appeal before which

every proposed new species for a certain large area must appear as for trial before it can be allowed to pass as valid. Though possibly good enough, unless approved by this tribunal, the faithful and discreet among botanists will not admit its validity, and must treat it as non-existent.

Of course, this kind of assumption—presumption, rather—is no new thing. There is another self-constituted tribunal of the same pretentions in New York, and this one, from certain points of view has better claims to being considered seriously. The members of its judiciary are much more experienced in everything relating to taxonomy. Only a moment ago we were taking note of the fact that New York, as reported by the symposium reporter, had in so far canvassed the species question as to be able to offer at least a rough estimate of the numerical proportion of recent species that might be suppressed; and, considering everything, that is no more startling than the statement of the New England judiciaries, that they, at whatever expenditure of time, and delay of publication, have been able to examine the data, and to decide upon the "merits" of most of "these new propositions," and with the result that only "in a few instances," and by lack of satisfactory data, have they failed to attain to sound conclusions as to the validity or invalidity of them. And that which to many a mind must seem extraordinary is, that in the cases of certain genera that have been most extremely enlarged by accession of new propositions, they have found the smallest number to discountenance, even often next to nothing to reduce or suppress. Their treatment of *Sisyrinchium* is apposite; for from a genus of 1 species in the edition of 1848, it had increased to one of 2 species in that of 41 years later; then in the space of hardly more than 10 years before the edition of 1908, it had acquired, in the opinion of our New Manual editors, as many as 11 more, making an aggregate of 13. For my own part, after thirty years or more of botanical travel and sojourning east and west, with frequent close inspection of members of this genus everywhere, and after the publication of a number of western and southwestern species, I should not have doubted about the possible, or probable, existence of even more than 13 species for this Gray's Manual region. As long ago as 1868, on the prairies of central Illinois, I came to realize the prefect validity of *S. albidum*, now of late restored; and in 1869, when my correspondence with Asa Gray began, I realized the utter futility

of attempting to impress such an idea upon the mind of that botanist. But now, as to the difficulty of the task which the editorship of the New Manual had before them in the case of this genus, my friend who did nearly all the original research on eastern and middle-western materials of it, will pardon my saying that, on account of great length and fullness of his descriptions of the new species, I could never hope for leisure to go through them all, and choose out the really distinctive characteristics of them; and that an editorial tribunal of the manual, itself unpracticed in sisyrinchial problems, could accomplish all this, and with even the bibliopole aspect of the species question unforgotten, could set the seal of approval to 13 species of this genus, almost all of them new, and also could "reduce definitely to synonymy" 3 others—all this is, under all the adverse conditions, a verdict judicial that, for the moment commands my admiration.

Less wonderful to me is a similar judgment rendered in the case of *Rubus;* for, notwithstanding that the accession of new species for this New Manual region, as admitted even by our editors, amounts to about twice the whole number ever before recognized in any edition, those new specific propositions—there are more than two dozen of them—have been presented to the public under conditions more than ordinarily favorable to their ultimate approval as valid. The very best data for new types are good descriptions; they are even better than good specimens, albeit good descriptions are perhaps as rare as are the professed taxonomists even who are competent to read and understand them. But Dr. Blanchard's descriptions of new brambles, as they have appeared from time in Rhodora, have impressed me as most lucid and satisfactory. I have adjudged them the most complete and the most intelligible diagnoses of new types that have ever been published in New England, and have felt that by them alone I might feel assured that his species were good, and also that I should be able readily to identify them by the diagnosis.

Here also I may as well remark that despite my having long been in rather proud possession of several unsought written encomiums on my own plant descriptions, some of these from the hands of men no longer with us, but who were of unquestioned high rank in matters of phytography, I am still half willing to attribute to failure on my part as diagnostician in this instance the fact that, out of 6 clear species which I imagined I had clearly con-

tributed to the phytography of this genus, one only has the editorship been able to "reduce definitely to synonymy", the other 5 having been left wholly without mention. If it were an exceptional or isolated' case of the treatment of my endeavors to improve the Manual region botany, I should freely accuse myself as an occasionally stupid phytographer; but instances of this kind of thing are so very numerous in the book that I begin to think there is another and still unnamed unscientific point of view, for which I have been considering the appropriateness of the designation, The Clansman's Aspect of the Species Question. I doubt however, about that name as sufficiently well devised. It may be too mild and lenient suitably to designate the invidiousness of that particular point of view. But the clannishness of two contending sets of American botanists has well been noted on the other side of the Atlantic; where also they themselves may be open to the same criticism. At home, I hope it may be coming to be recognized that we have one botanist, whose prominence before the entire world botanical, whose strong influence at home none will dispute except in whisperings behind his back, who openly and serenely defies the clanishness of both clans, conscious of power to stand, to dare and to do against the envy and the malice of the envious and malicious who abide among the kind and friendy in either clan.

There is another genus named in the list above on the specific growth of which I can not forego brief remark. In the new book *Panicum* taking the genus in that broader acceptation of it exemplified in the edition of 1889—has grown from 23 species to 83. In nineteen years, then, 60 species have been added to it most of them new, and that is saying that the membership of this genus has been almost trebled within less than 20 years; and a noteworthy fact about it is, that only 15 species that have been described as new have been reduced to synonymy.

This *Panicum*- a most critical and difficult genus -and the 82 other genera of the grasses, have been prepared for the book by a contingent of the editorship which seems to have had grace to avoid party entanglements, and in its work does not evince distinct alliance with either clan. In the fulfilment of its task it does not seem to have been obliged to take for a moment the bibliopole aspect of the species question, and has been permitted to do ,its work in a spirit of candor and simplicity; the only spirit by

which to ensure truly scientific results. Very possibly a spirit of unalloyed sincerity has ruled the revision of the Cyperaceae; for here, for the whole family, a very large one, rich in species by American authors of the early and the middle periods of the nineteenth century, the editor has put forward but 10 new ones of his own specific propositions, and has suppressed only some 25 that have been proposed by other authors of his own time.

The statistics of *Crataegus*, as I have given them above, appear startling; for we who have had too much else to do all the while have heard all sorts of tales about superlative species making in this genus, and all within the last ten years. The figures show for the new manual, only a six-fold increase in the number of *Crataegus* species since 1889; and *Antennaria*, a genus which has been much less talked about, has increased in the number of admitted species more than tenfold. But then, of the 10 species which in the new book are added to the one which was in the older books 7 are mine; the other 3 also appeared for admission later, and as under my immediate discipleship, and but for my having shown where the characters for antennaria species are to be found, it is scarcely probable that the book of 1908 would have differed from its predecessors as to membership of *Antennaria* for the Manual territory. But there was with me a limit to the possibilities of antennaria expansion; a limit set by nature, apparently; for I believe I did not discover and publish, for the whole of North America, to exceed 35, or at most, 40 species. How very different the history of *Crataegus* within the same recent period. I have been assured by one who has had some part in the investigation of that genus that about 1000 American species have now been published; even the greatest proportion of them haling from the United States and Canada. It appears that about 600 species had been added to the genus for the Gray's Manual region at about the time of the issue of the 1908 edition. And so, inasmuch as said edition has but 55 species over and above the 10 species of the issue next preceding, the 600 proposed new ones have been brought down by the suppressive skill of the editorship to the remarkably small number of 55. Then again making a canvass of the *Crataegus* pages of the manual in quest of such of the new ones as the editorship has been able to "reduce definitely to synonymy," if no error has been made in the counting, the coincidence is curious, that these also number 55; and we have now,

as named and accounted for in one way or another, the sum of 110 of 600 published new ones, while the "few" which remain totally without mention are 490. Considering the hundreds of genera treated in the volume, and the very great number of them in which new species have been published within ten years, and noting as we do many large genera in this flora, to some of which decades and even scores of species have been contributed within a dozen years, besides a much greater of small genera which have been thus augmented in the same proportion, in the aggregate of which only here and there a newly added species has met with any mention in the book, it may be inferred almost to a certainty that a total of a thousand or more of this sort exist; and a thousand can not be called "a few." The botanical public may claim a right to more well considered and fairer statements than this and others which seem to have been thrust into this Preface without reflection, and, I dare add, without conscience. In order to show warrant for so severe a statement as this, and at the same time to impress more deeply the truthfulness of it, I go back to *Crataegus;* and in resuming the thread of former discourse upon it I shall first confess to have taken something like self-gratulatory satisfaction in following the extraordinary increase of late years in the proposed species of this genus. Me, to whom aforetime all the making of superfluous new species was attributed—me have the several specialists in *Crataegus* so far outstripped, that I am left almost an extreme conservative, in peril of coming to be called a "mossback." What are my two score antennarias and three score violets—all of them herbs, and of plastic and mutable nature and temperament—what are these few scores of my species here, compared with 600 new species in one genus of trees, all on the same extent of territory? And it is a genus not only of trees, but of slow growth and slow and scanty multiplication of individuals; a genus in which the evolution of distinct types must proceed with incalulable slowness in comparison with such things as violets, the individuals of which may be presumed to multiply a million a year to one of crataegus. I suggest to my friends of the Chicago Symposium that they cease from quoting the Jordans and Gandogers of Europe for their illustrations of excessive species making. The plant they call *Draba verna* inhabits almost all temperate Eurasia and America, flowering in untold millions of new individals every year, in multitudinous diversities of soil and climate; and 60

definable segregates of this would seem a hundred times more probable than 600 segregates of *Crataegus* in northeastern and middle western North America.

At the beginning of this development of white thorn species, I regarded the rapid progress of it, as did others, with amazement and was disposed to be altogether incredulous. The whole proposition involved too many improbabilities. I have not attempted any study of the forms existing in any locality where I have been, I have never published more than one new *Crataegus*, and that was done before the new movement took its rise, and had nothing to do with it. There are, however, some recent experiences of mine which have induced quite a change in my attitude toward the crataegus movement. In my annual excursions westward, northward and even eastward, I have met with more than one, or two, or three local amateur botanists to each of whom in his own district, a number of white thorn species was known familiarly, and by name; men who would disclaim all accurate knowledge of their numerous violets, meadow rues and antennarias; and the reason of their familiar acquaintance with a number of crataegi I soon learned. The locality of each such resident botanist had been visited by Professor Sargent. They had conducted him to their woodland border thickets, their open slopes and their more level cow pastures where there were thorn trees, and he had indicated to them the specific marks of the different kinds; and so, such local disciples of his were able to remove many a doubt of mine. I have been brought to an attitude of receptivity on the crataegus question. But what is more germain to the argument is that, since the new manual came out, they fail to find therein so much as the names of some of the species that they had reckoned among the best. Within the two seasons last past, I have heard this same complaint from different people and belonging to localities remote from one another; nor could it be otherwise if, as it plainly appears now, 490 out of the 600 newly published kinds of thorns are left without mention in the book.

In one place and in another, quite within the manual limits I have been conducted by local botanists,—the names of several of them are of reputation in the science—to the various habitats of several of the violets of their vicinity, species whose distinctness every plant lover of the district is so well assured of as not to doubt their title to the specific names that have been given them, and had

been given them as new in the interval between two editions of Gray's Manual; and this done, I have been asked why such unquestionably good species have not been so much as mentioned in the new manual. This experience has been mine in two or three different and widely separated states and provinces that lie within the limits which the book pretends to cover.

Over and above the multitude of the teachers and their pupils in the schools, there are two classes of what we may call lay botanists collectors and amateurs, into whose hands the manuals of botany fall. These outsiders, if we may so designate them, are of service to the science in many and in different ways; and they are of two distinct classes. One class studies nature and observes and compares plants, each man of them with his own eyes, and forms some opinions of his own and does not renounce these opinions for the mere reason that several books of descriptive botany set forth opposite views.

The other class distinguishes itself by looking at nature and studying plants, as it were only through the eyes of the men who have written books. These will seem to hold in such deep veneration the newest edition of their chosen manual, that they will force Dame Nature herself to conform to the rule and dictum of the authorship of that one book. The volume will seem to be regarded as scientifically without spot or blemish, and an absolute finality on all questions of the rank of groups, and of the nomenclature of them; and if a man of this type should ever engage in a bit of real research that would seem to threaten the soundness of a dictum of his editorial scientific lords and masters, he would be likely to drop the investigation at the bidding of such authority, lay his fingers to his lips and whisper *peccavi.*

Each of these types of the lay botanist does useful, even admirable work for the science. They explore, singly or collectively the native vegetation of a town, a county, or a state; they gather personal or club or society herbaria, and these are first-class repositories of fact, small matter what little book is sworn by in matters of classification and naming, whether Robinson and Fernald's—so very ineptly named "Gray's"—or Britton and Brown.

And the independent class, they who dare to have ideas of their own, and venture to look into nature freely, and fear not the botanical dogmatist—these, while their attitude, and theirs alone is the really scientific attitude, and the one sure to be the most

fruitful of results,—these are apt to display a forwardness in proclaiming their discoveries which the venerative and submissive party is saved from.

If freedom of botanical research, and the practice of scanning nature with one's own eyes rather than through those of dogmatic, domineering and repressive makers of books,—if this, on the whole, and scientifically viewed, is the better way, then that was a propitious day for East North American botany which gave to it Britton's Manual. Even though in respect to this book there would be found a contingent who would pay it undue veneration, this was of no moment compared with the fact that the right of the old imperium to its usurped supremacy should be in this bold emphatic manner disputed.

This new manual, emanating from New York, affirmed,—and eventually, along with other great botanical events, each of equal import, confirmed—the strong establishment of a new centre of zealous work, and the seat of a powerful rival authority on systematic botany. The book itself looked almost thin and small by the side of the Gray's Manual of 1889; but that was because of differences in paper, and in the compactness of the pages in the New York volume; but when this book was opened you found it contained almost 1100 pages of this small-type printing in crowded paragraphs. The Gray's Manual of the edition next preceding this, with its more comely setting and paragraphing, giving to less matter much more space, showed but 750 pages. Possibly,—I may even venture to say probably—had the matter of the Gray's book of 1889 been printed in the same style and type, and on the same thin paper, the whole would have been reduced to 600 pages if not to 550, or half the bulk of the Britton book. I feel quite sure in saying that the matter, mainly descriptive, of Britton's Manual of 1901 must amount to one-third more than that of the edition of Gray which was practically its contemporary book. And the very much greater bulk of the New York book will be found partly due then to hundreds of excellent species of early authors which, suppressed without reason in all the editions of Gray, Dr. Britton and his collaborators had investigated, found valid and restored; also partly, and more largely to new discoveries which had been made in an empire of botanical ground which Dr. Gray all his long life time had supposed to have been long exhausted.

And now, there was I think little or no working here from the bibliopole standpoint on the species question. It appears as if there must have been an honest purpose to describe all the known vegetation of the territory embraced, regardless of the cost of printing, and in trust that the work would nevertheless be a success financially; and in this there was no disappointment if one may judge from the number of new impressions that have been made within the 9 years since the first issue was given forth.

I am unwilling to put a period to the expression of these thoughts without adverting to another manual; one which, as to the great cost of publication, and the author's apparent indifference to the risk of pecuniary loss or gain, ought to be distinguished and celebrated as in contrast to the penuriousness that governs manual making under corporate institutions that roll in wealth. Need I name, after such preamble, the book and its author? Certainly I mean Dr. John K. Small's Flora of the Southern States. Printed in good style, on good paper, it is a volume of almost 1400 pages of purely descriptive botany; and I can not doubt that in the printing it has been the most costly —even by far the most expensive—one volume of such work that has been issued in this country; and at the low price at which the book has been sold, I do not see how the author could have expected to make profit. It may well be that the principal invested has by this time been restored; certainly very little of the interest on it, if any at all. It is a great piece of good fortune to the botany of that subempire, our South, that an able and zealous botanist can afford to do his chosen work, and issue his splendid volume without descending to take the unscientific and bibliopole aspect of the species question, and can not go down to that abject viewpoint, the clansman's outlook on the same.

A New Genus of Rubiaceae.

J. A. NIEWLAND.

The genus *Galium* of Linnaeus is composed of several distinct types of plants, as, for that matter, are most of the Linnaean genera. It is a composite of several older ones, especially *Aparine* and *Galium* proper, both names originating with the ancient

Greeks and Theophrastus, also of *Cruciata* of Tournefort, 1694. All these pre-Linnaean genera, which were also restored and recognized since 1753, agree in having dry fruits, some smooth others more or less hispid. *Galium hispidulum* Michx., 1803 and *Galium uniflorum* Michx., 1803, among other differences, have a decidedly berry-like fruit.

Wherever in other genera there had been aggregated plants with dry and others with fleshy fruit it was not long before such a variation was made the basis of generic distinction, and nearly if not all such generic segregates have been accepted and have stood the test of time and criticism. Examples need not be quoted numerous though they be; in fact even sub-families and families have been made with little other distinction than this.

Galium hispidulum Michx., has been referred to *Relbunium* a Mexican and southwestern genus, which differs in having a subfloral envelope of green leaves. Some hesitation as to placing the plant in *Rubia* has been felt; and under these circumstances it would seem best to constitute it as the type of a new genus which I propose to call **Bataprine.** The name comes from the Greek *βάτος*, a berry, and *ἀπαρίνη*, the ancient name for cleavers. The last part of the name was purposely shortened to prevent it from falling under the ban of the excellent rule of Linnaean nomenclature forbidding the formation of one name from previously existing ones,* a rule which is unfortunately little regarded by modern nomenclators.

Bataprine, Nov. gen.

Perennial hirsute or hispid plants, branching considerably: leaves rather thick whorled, one-nerved, mucronate: flowers white, few, at the ends of small branches: pedicels stout reflexed in fruit which is a black berry, glabrous or minutely pubescent: ovules one in each half of the berry. Otherwise as in *Galium*. Plants of the Southeastern coast region of the United States.

BATAPRINE HISPIDULA (Michx.) Nwd.

Galium hispidulum Michx., 1803.

BATAPRINE UNIFLORA (Michx.) Nwd.

Galium hispidulum Michx., 1803.

* Linnaeus, C. V. Philosophia Botanica, 1755.

Migration of Our Birds in the Spring of 1910.

BROTHER ALPHONSUS, C. S. C.

The following birds arrived from five to ten days earlier than last spring: Bluebird, Killdeer, Phoebe, Vesper Sparrow, Golden Crowned Kinglet, Hermit Thrush, Brown Thrasher, Scarlet Tanager, Least Fly Catcher. The very mild weather from the 18th of March until the 16th of April, with a temperature of 59° or higher, for two-thirds of the time, accounts for the marked difference in the dates of arrival between this year and last of the above-named species.

The Flicker, Field and Chipping Sparrows, Sapsucker, Towhee, Hell Diver, Red-headed Woodpecker, Cardinal, Ruby-crowned Kinglet, Alder and Crested Flycatchers also arrived from twelve to thirty days earlier. The warm weather was, if not directly, at least indirectly the cause of the very early arrival of these birds.

A few species arrived considerably later than last spring. Among these were the Indigo Bird, Barn Swallow, Myrtle and Yellow Palm Warblers. The cold weather following for a month after April 16th was, doubtless, the reason why these species arrived so much later.

Ten species were not seen this spring. They were the Purple Finch, White-crowned Sparrow, Wilson's Thrush, Ovenbird, Blackburnian, Canadian, Tennesse, Hooded, Kentucky Warblers.

Feb.	22	Bluebird
March	4	Killdeer
"	4	Robin
"	4	Loggerhead Shrike
"	5	Red-winged Blackbird
"	5	Song Sparrow
"	6	Purple Grackle
"	6	Meadowlark
"	6	Canada Goose
"	6	Herring Gull
March	16	Cowbird
"	19	Towhee
"	20	Prairie Horned Lark
"	24	Flicker
"	25	Field Sparrow
"	26	Vesper Sparrow
"	26	Yellow-bellied Sapsucker
"	27	Chicken Hawk
"	28	Tree Sparrow departed

March	28	Mourning Dove
"	29	Phoebe
"	29	Chipping Sparrow
"	29	Hairy Woodpecker
"	30	Golden-crowned Kinglet
"	30	Brown Creeper
"	30	Kingfisher
"	31	Hell Diver
April	1	Brown Creeper departed
"	2	Goldfinch
"	4	Hermit Thrush
"	4	Red-headed Woodpecker
"	5	Tufted Titmouse
"	7	Cardinal
"	10	Brown Thrasher
"	10	Ruby-crowned Kinglet
"	12	Sparrow Hawk
"	26	White-throated Sparrow
"	27	Golden-crowned Kinglet departed
"	27	Barn Swallow
"	28	House Wren
"	30	Spotted Sandpiper
May	1	Canvasback
"	2	Myrtle Warbler
"	2	Yellow Warbler
"	2	Yellowlegs
"	2	Baltimore Oriole
"	3	Warbling Vireo
"	3	Yellow Palm Warbler
"	4	Yellow-throated Vireo
May	4	Kingbird
"	4	Redstart
"	4	Snipe
"	4	Downy Woodpecker, departed
"	5	Yellow-bellied Sapsucker, departed
"	5	Ruby-crowned Kinglet departed
"	7	Catbird
"	8	Snowbird departed
"	8	Purple Martin
"	8	Rose-breasted Grosbeak
"	8	Chimney Swift
"	10	Black-throated Green Warbler
"	10	Scarlet Tanager
"	10	Chickadee
"	10	Crested Flycatcher
"	10	Orchard Oriole
"	10	Black and White Warbler
"	11	Maryland Yellow-throat
"	12	Alder Flycatcher
"	12	Dickcissel
"	14	Bobolink
"	14	Least Flycatcher
"	16	Bay-breasted Warbler
"	17	White-throated Sparrow departed
"	17	Indigo Bird

May	17	Black and White Warbler departed
"	18	Yellow Palm Warbler departed
"	18	Black-throated Green Warbler departed
"	18	Least Flycatcher departed
"	18	Water Thrush
"	19	Hummingbird
"	20	Myrtle Wrabler departed
"	20	Wood Pewee
"	21	Red-eyed Vireo
May	22	Rose-breasted Grosbeak departed
"	24	Pine Warbler
"	30	Yellow-billed Cuckoo
June	1	Cedarbird
"	3	Nighhawk
"	6	Yellow-bellied Flycatcher
"	8	Hermit Thrush departed
"	15	Screech Owl
"	15	Whip-poor-will
"	19	Downy Woodpecker

Total number of migrants seen, 80.

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ERRATA

Page 233, line 16, read "It is *not* found," etc.

Page 264, last line for *Galium hispidulum* Michx., read *Galium uniflorum* Michx.